

APPENDIX A

ISSUES, CONCERNS, AND OPPORTUNITIES

INTRODUCTION

This appendix discusses the:

- Process used to identify the issues, concerns, and opportunities (ICOs) through publication of the Draft Environmental Impact Statement (DEIS).
- Relationships among resources within and between key issues, human interests affected by varying responses to those key issues, refinements and changing focus of public and internal interest about five key issues during the interval between publication of the DEIS and Final Environmental Impact Statement (FEIS); the location in the FEIS and Land and Resource Management Plan (LRMP) where the issues are addressed; and the indicators which can reasonably be used to judge responsiveness to the issues.
- Consultation with others.

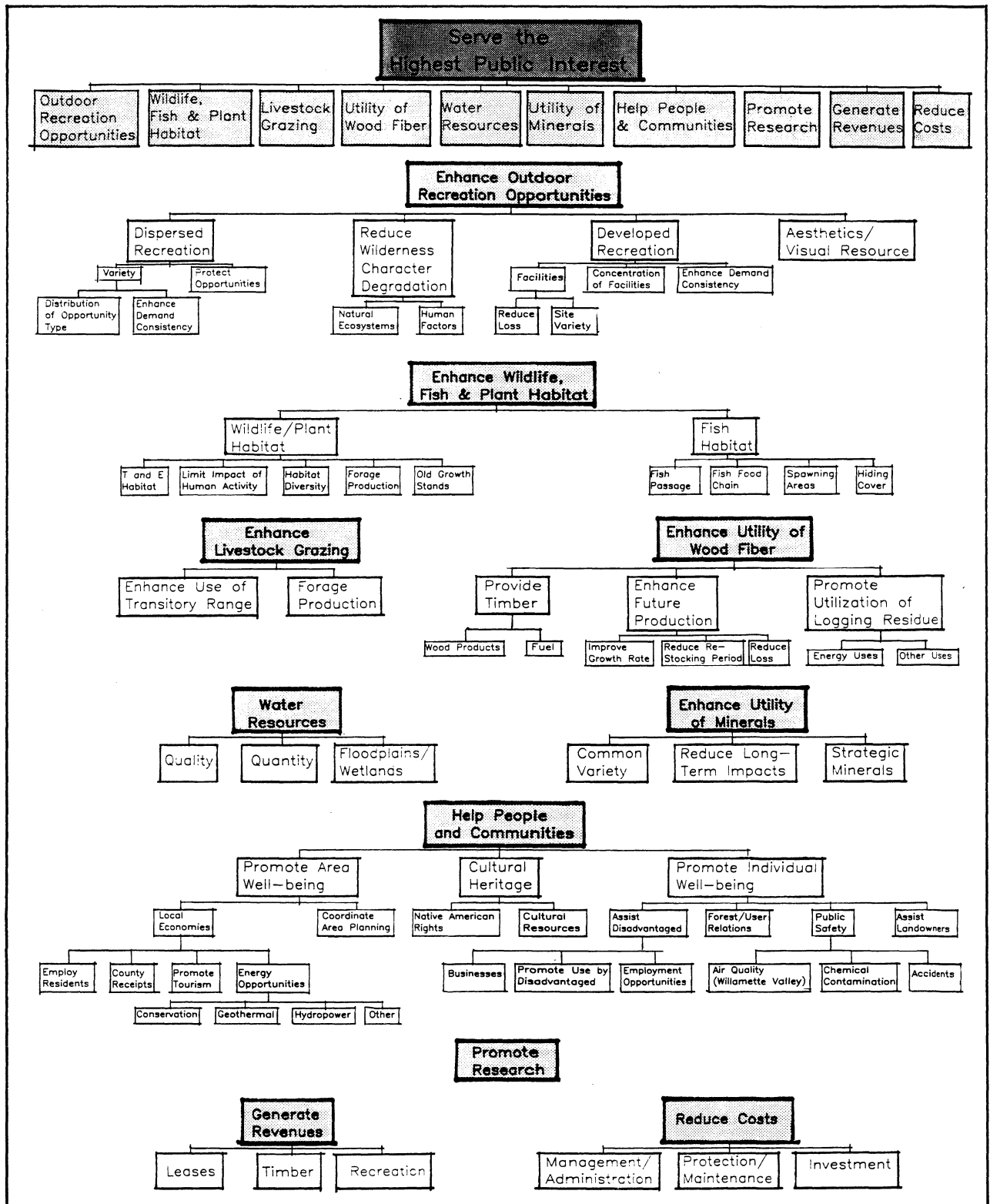
The first section is the description of the ICO identification process through publication of the DEIS. This section addresses: how issues were formulated; how their importance and weight were assessed; the criteria used to determine the capability of the Forest Plan to address the issues; the validation and revision of the objectives hierarchy; and a general description of the facets to the issues which could be addressed through allocation of resources available to the Forest.

The second section discusses the major issues and their disposition. It contains three subsections. The first subsection discusses in greater depth certain "key" or major issues which were of relatively greater importance in the selection of a preferred alternative. Those key issues are explored in terms of the relationships between resources both within and between the key issues, as well as in terms of the competing human interests served by varying management responses to those issues. The second subsection briefly discusses refinements to five of the key issues resulting from public and internal input during the interval between the DEIS and FEIS. The third subsection directs the reader to those chapters within the FEIS and LRMP where the issues are given intensive treatment. It also displays the principal indicators and the quantitative measures which can be used to judge responsiveness to the key issues and economics.

The third section describes outreach made to consult with other agencies, groups, and Indian tribes which was in addition to general public involvement activities. These contacts were made because these agencies, groups, and tribes were believed to have special interest or expertise in the forest planning process.

Appendix A bears a special relationship to Appendix I. Readers are encouraged to consult Appendix I for a more complete understanding of the range of the issues, concerns, and opportunities the public believes faces the management of this Forest.

Figure A-A-1



Issues, Concerns, And Opportunities Identification Process

The process of issue identification through the publication of the DEIS began in the fall of 1979. The formal announcement of the intent to prepare an Environmental Impact Statement for a new Willamette National Forest Management Plan was published in the Federal Register and local newspapers.

An initial comprehensive draft of existing and anticipated issues, concerns, and opportunities was circulated on-forest to Rangers, Staff, and Zone Engineers for review and comment. Several questions and topics were presented under the following subject areas: Protection (Fire, Insects, and Disease); Wilderness Management; Visual Resource; Chemical Use; Human and Community Development; Cultural Resources; Use Permits; Water; Land; Soils; Plant and Animal Diversity; Transportation; Recreation; Timber; Threatened and Endangered Animals; Range; Resident and Anadromous Fish; Riparian; Energy; Geothermal and Other Energy; Minerals, including Common Variety.

The issues, concerns, and opportunities were expressed as objectives, and a hierarchy was developed. Figure A-A-1 is a schematic representation of this hierarchy. At the top appears the broadest, most general objective of Land and Resource Management Planning. Each successive layer further defines the broad purpose. At the bottom the most specific statements of the objectives are expressed. Narrative definitions explaining each of the objectives were reviewed by Forest Service employees who were judged familiar with public opinion to assess the completeness of the objectives hierarchy. Another review by the Forest's Management Team followed.

Next a response packet to solicit public comments was prepared. The packet used the hierarchy as a framework and contained three items. The first was a newsletter explaining the planning process and describing the need for public participation. The second was a booklet discussing the anticipated issues for this round of planning. Facets to these issues were developed from specific statements in the objectives hierarchy and were included in the booklet. The third item was a response form for return to the Willamette National Forest Supervisor's Office. The packets were mailed to over 1,000 names and addresses on the Forest's planning contact list, and another 300 packets were distributed from the various Forest offices and during meetings with various organizations.

The specific issue subject areas listed in the public response packet were:

- *Dispersed Recreation:* To provide a range and a quantity of opportunities.
- *Developed Recreation:* To provide a range and a quantity of opportunities.
- *Wilderness:* To allow for the uninterrupted functioning of the area's natural processes.
- *Aesthetics:* To provide opportunities for a pleasant visual experience for all visitors to the Forest.
- *Wildlife/Plant Habitat:* To provide for plentiful and diverse habitats.
- *Fish Habitat:* To provide habitat for anadromous and other fisheries.
- *Livestock Grazing:* To provide for livestock forage production and the use of the Forest's transitory range.
- *Current Production:* To provide timber in the present decade for wood products.

- *Future Production:* To provide for supplies of timber continuing beyond the current decade.
- *Utilization of Slash:* To promote the use of slash for energy production and other uses.
- *Water Quality:* To provide high quality water for municipal watersheds, fish habitats, and other uses.
- *Water Quantity:* To provide sufficient quantities of water to meet demand.
- *Floodplains/Wetlands:* To provide for the natural functioning and to protect their productivity.
- *Minerals:* To provide for the extraction of common, precious, and strategic minerals.
- *Area Well-Being:* 1. Local Economies: To promote the economic health of local areas.
- *Area Well-Being:* 2. Energy: To facilitate the development of sources of potential domestic energy.
- *Cultural Heritage:* To protect the cultural, historic, and natural aspects of our national heritage. This includes protecting the rights of Native Americans.
- *Individual Well-Being:* To promote public safety and provide assistance to landowners and the disadvantaged.
- *Promote Research:* To promote research in various fields of study by identifying needs and cooperating with researchers.
- *Generate Revenues:* To generate receipts for the Federal general fund.
- *Management Efficiency:* To use cost-effective methods of providing Forest outputs.

Open house sessions were held to explain the issues packet and response forms, as well as opportunities to participate in the Forest's planning process. The open house sessions were informal, offering assistance in preparing response forms and answering questions. The Eugene Open House, November 24, 1980, was attended by 61 people. The Salem Open House, November 25, was attended by 22 people. The Albany Open House, November 25, was attended by 11 people.

Response forms were due back January 2, 1981. 291 forms were returned out of the 1,300 distributed. An additional 41 items of correspondence were submitted and were included in the analysis process.

Through the open house and response packet process, people were asked to rate the importance of the issues, suggest revisions, and give supporting reasons and comments. Figure A-A-2 shows how the public rated the importance of each of the 21 issues.

People were also asked to weigh or rate the relative importance of the issues after they were grouped into 10 resource categories, by allocating a total of 100 points across the 10 categories. Figure A-A-3 presents the results of this exercise.

No formal updating of the relative ratings and rankings of the issues represented in Figures A-A-2 and A-A-3 was conducted for the FEIS. A discussion of what the Forest considers the major refinements

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of issues since the early 1980s can be found later in this Appendix in the subsection "Issue Refinement Between the DEIS and the FEIS."

Table T146. Issue Importance ¹ (Figure A-A-2)

Issue No.	Issue Subject	Very Important	Fairly Important	Not Important
1.	Dispersed Recreation	44	44	8
2.	Developed Recreation	33	52	11
3.	Wilderness	55	30	12
4.	Aesthetics	33	49	15
5.	Wildlife/Plant Habitat	63	34	6
6.	Fish Habitat	56	37	3
7.	Livestock Grazing	6	28	61
8.	Current Production (Timber)	64	27	6
9.	Future Production (Timber)	84	13	1
10.	Slash Utilization	55	28	14
11.	Water Quality	82	14	1
12.	Water Quantity	42	34	21
13.	Floodplains/Wetlands	49	36	11
14.	Minerals	22	48	24
15.	Area Well-being; Local Economies	45	38	13
16.	Area Well-being; Energy	42	41	12
17.	Cultural Heritage	32	37	27
18.	Individual Well-being	24	47	24
19.	Promote Research	46	34	17
20.	Generate Revenues	40	39	17
21.	Management Efficiency	62	28	5

¹Figures Indicate Percentage of Importance Respondents Assigned Each Issue on Response Form

Table T147. Issue Weights ¹ (Figure A-A-3)

Issue Numbers on Response Form	Resource Category	Weight
1, 2, 3, 4	Outdoor Recreation	13
5, 6	Wildlife, Plants, Fish	14
7	Livestock Grazing	2
8, 9, 10	Timber	21
11, 12, 13	Water Resources	13
14	Minerals	4
15, 16, 17, 18	Human and Community Development	7
19	Promote Research	6
20	Generate Revenues	7
21	Management Efficiency	8

¹Calculated by resource category.

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Development of the final list of issues for Regional Forester review and approval involved analyzing the public responses received in early 1981. One step in this analysis involved assessing the capability of the Forest Plan to address each issue:

1. Was the issue or concern within the legal responsibility of the Willamette National Forest?
2. Did the issue or concern pertain to the responsibility of other Federal, State, or local governmental agencies?
3. Could the issue or concern be resolved by the National Forest Management Act (NFMA) planning process?
4. Could the issue or concern be best resolved at the National, Regional, or Forest level?
5. Did the issue or concern affect: (a) Forest land-use patterns, or (b) the nature, quality, or quantity of outputs from the Willamette National Forest?
6. Could the issue or concern be resolved more effectively through other already existing management processes, such as environmental assessments, policy statements, manual supplements, or project work plans?

The final phase of the analysis had as its central theme the goal of validation or revision of the objectives hierarchy from suggestions and comments contained in the response documents.

First, every comment about an issue was read and paraphrased onto lists under appropriate headings. After all responses were listed, each was compared to the descriptions of the most specific statements of objectives from the objectives hierarchy. If the specific statement of objectives adequately described a given response, a code was assigned to the paraphrased comment linking it to the appropriate position within the hierarchy. If no existing specific statement of objectives adequately described a given response, a new description was added to the appropriate section of the hierarchy and the paraphrased comment so coded.

A finalized list of 19 issues was sent to the Regional Office with the accompanying comments:

1. While the final regulations suggest that we do not consider additional areas for Wilderness designation, many of the public expressed their desires that this issue be addressed.
2. The issue of old-growth management is treated under the timber production issues and the wildlife/plant habitat issue.
3. The firewood issue is considered a part of four other issues.
4. The issue of the use of herbicides and chemicals in general is addressed in terms of growth rate, wildlife/plant habitat, water quality, and public safety.
5. Transportation system management is addressed as it relates to access timber, recreation and wilderness, mineral sources, and for the physically disadvantaged.

The result of Regional Office review was modification of the document to incorporate the issue named "Promote Research" as a component of other issues, instead of treating it separately. In October 1981 a document listing the following 18 issues (planning questions with their facets) was published:

1. CURRENT TIMBER PRODUCTION

What emphasis should the Willamette National Forest place on providing timber supplies during the present decade?

FACETS: Production of timber on the shortrun basis involves developing or applying technologies to: improve product utilization in the woods and at point of manufacture (or use as firewood), harvest of difficult or sensitive areas, accomplish reforestation of cutover lands, provide access, and intensify cultural treatments sensitive to environmental concerns.

2. FUTURE TIMBER PRODUCTION

What emphasis should the Willamette National Forest place on providing timber supplies beyond the present decade?

FACETS: The determination of the productive land base, the intensity of applying management practices, and the rate of old-growth harvest are the most important aspects of this issue. Improvements in growth rate (possibly using fertilizers); reducing the restocking period; and limiting losses due to fire, waste, disease, and pests (possibly using pesticides or other chemicals) are additional concerns.

3. LOGGING RESIDUE

What emphasis should the Willamette National Forest place on achieving the utilization of logging residues?

FACETS: Logging residue as an alternative energy source. Maintaining natural decomposition, wildlife habitat, and nutrient cycling are some of the considerations. Recognition of air quality standards, cost-effectiveness, and accessibility are other important concerns.

4. WILDLIFE AND PLANT HABITAT

What emphasis should the Willamette National Forest place on promoting habitat for wildlife and plant species?

FACETS: Habitat richness is the relative degree of ability of a habitat to produce numbers of species of either plants or animals; the more species produced, the richer the habitat (Thomas, J. W., Wildlife Habitats in Managed Forests, USDA Forest Service, Ag. Handbook No. 553, 1979). Management of wildlife and plant habitat requires special consideration for threatened, endangered, and sensitive species, wildlife forage production, old-growth habitat and the impact of human activities upon wildlife and plant communities. Opportunity costs of promoting habitat richness; intensity of Forest management practices (possibly using fertilizers, pesticides, or other chemicals); and coordination with the appropriate Federal, State, and local agencies are additional considerations.

5. AQUATIC HABITAT

What emphasis should the Willamette National Forest place on providing habitat for aquatic species?

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FACETS: Providing habitat and quality fisheries requires consideration of fish migration routes, food chains, spawning areas, hiding cover, and water suitability. Opportunity costs of providing and maintaining aquatic habitats; intensity of Forest management practices; and coordination with the appropriate Federal, State, and local agencies are additional considerations.

6. DISPERSED RECREATION

What emphasis should the Willamette National Forest place on providing dispersed recreational opportunities?

FACETS: Providing a range and a variety of dispersed recreation opportunities outside wilderness involves considerations of how much and what types, location, conflicts, and compatibilities among users and uses, and proximity to population centers. In addition, the quality of opportunities to be provided is an important aspect of these considerations.

7. DEVELOPED RECREATION

What emphasis should the Willamette National Forest place on providing a range of developed recreation opportunities?

FACETS: Providing a range of developed recreation opportunities requires consideration of facility types, distribution throughout the Forest, proximity to population centers, and demand patterns. Facility design standards and maintenance levels are important quality considerations.

8. WILDERNESS

What emphasis should the Willamette National Forest place on managing existing wilderness areas?

FACETS: Management proposals for wilderness areas must address the relationships between natural processes and human activities. Resource degradation and the disruption of natural processes are functions of the amount of use, user distribution, and behavior.

9. SCENIC RESOURCE

What emphasis should the Willamette National Forest place on providing a variety of pleasant scenic experiences?

FACETS: While providing other benefits, management of the scenic resource involves considerations of actual treatment, design, and the amount and rate of management activities occurring in the landscape. In addition, important factors to be addressed include specific practices, techniques, and methods, as well as the extent of their applications.

10. WATER PRODUCTION

What quality and quantity of water should the Willamette National Forest produce?

FACETS: Water, as defined in terms of quality and quantity, is influenced not only by natural conditions but by the scope, timing, location, amount, or intensity of management actions. Of these actions the manner in which the riparian zones are treated is very important.

11. ECONOMIC EFFICIENCY

What is the tradeoff between efficient allocation of resources and the production of desired levels of outputs on the Willamette National Forest?

FACETS: The concept of economic efficiency implies a commitment to high quality investments based upon careful consideration of all benefits and costs, many of which are not readily quantifiable. An important aspect of operating in a cost-effective manner is reducing costs; one method may be through the use of increased contracting.

12. LOCAL ECONOMIES

What emphasis should the Willamette National Forest place on providing outputs and services in response to local needs?

FACETS: Maintaining land and resource management options may be more important than the production of a single output. Important considerations in determining the appropriate mix of programs for local economic stability include the amount and distribution of revenues produced by the Forest, the need for diversification of local economies, the relationship between Forest management practices and labor hiring policies, and the amount of preferential treatment given to small businesses.

13. ENERGY

What emphasis should the Willamette National Forest place on the development and conservation of energy sources?

FACETS: Potential sources of energy currently emphasized include hydropower, geothermal, and fuel wood. Additional concerns include conservation of energy in Forest activities and the provision of powerline corridors for energy transmission.

14. INDIVIDUAL WELL-BEING

What emphasis should the Willamette National Forest place on individual well-being?

FACETS: Individual well-being entails civil rights, including Native American rights, public safety (including the safe use of chemicals), employment opportunities, and assistance to landowners and the physically and economically disadvantaged. In addition, opportunities exist to improve access, particularly for the physically disadvantaged, and to make environmental education available to the public.

15. CULTURAL RESOURCES

What emphasis should the Willamette National Forest place on the cultural resources program?

FACETS: The cultural resources program involves the identification, interpretation, and protection of the cultural, historic, and natural aspects of our national heritage.

16. MINERALS

What emphasis should the Willamette National Forest place on the management of mineral resources?

FACETS: The primary aspects are the exploration and the removal of common variety, precious, and strategic minerals, particularly in the next decade. Land reclamation is particularly important for reducing long-term impacts on other resources.

17. AIR QUALITY

What emphasis should the Willamette National Forest place on maintenance of air quality?

FACETS: Air quality concerns include the production of smoke, dust, and other particulate matter and the need to keep particulates from intruding into Class I and Class II areas.

18. LIVESTOCK GRAZING

What emphasis should the Willamette National Forest place on providing for livestock forage production and the use of the Forest's transitory range?

FACETS: Dealing with livestock forage production and transitory range use involves considerations of enhancing use, forage production, and livestock management to avoid impacting other resource values.

MAJOR ISSUES AND DISPOSITION OF ISSUES

Major Issues

By the time of publication of the DEIS, modifications were made to the 1981 list of primary issues. These modifications were made to reflect refinements in public opinion during that interval and to reduce complexity within the planning documents. In some cases closely interrelated issues were grouped together. Examples include consolidating "Aquatic Habitat" into "Wildlife, Fish, and Plant Habitat;" and combining "Current and Future Timber Production" into one issue named "Timber Supply." Other topics, such as Old Growth and Roadless lands, had increased in public interest to such a large degree that they were then being treated as separate issues.

While all of the issues were considered during the development of the DEIS Alternatives, the degree of response to the major ones was of greatest importance in selecting the Preferred Alternative for the Draft Forest Plan. Issues were considered of "major importance" if they were the subject of continually recurring correspondence, individual visits, or meetings involving other public agencies, organized groups and industry, or the public at large. These issues were also often discussed in media reports. The major issues that provided the focus for the DEIS were Dispersed Recreation; Old Growth; Roadless Lands; Scenic Quality; Timber Supply; Water; and Wildlife, Fish, and Plant Habitat.

A brief discussion follows about each of the seven major, or "key" issues which were the subject of special focus in the DEIS. These key issues, with some refinements discussed later in this Appendix, remain the major issues considered in the FEIS and Final Forest Plan. In addition, readers are encouraged

to read Chapters I and III of the FEIS for a more complete discussion of the interrelationships and conflicts among resources.

Dispersed Recreation

Demand for recreation opportunities on the Forest remains high. People are interested in maintaining a wide variety of options for recreation activities. The subject of roaded and unroaded dispersed recreation opportunities carry the greatest potential to vary among Alternatives. There is concern about how the management decisions made in the Forest Plan will increase or decrease these opportunities.

There is continuing, although somewhat less intense, interest in managing for developed recreation, as well. Developed sites are tracked through the process; but they are not treated as a major issues, because there is less land involved and less intensity of public interest. Decisions made regarding developed recreation have a low significance in affecting the overall management of other Forest resources.

Old growth

In the early stages of development of this Forest Plan, the management of old-growth stands was considered part of the timber production and fish and wildlife habitat issues. By the publication of the DEIS, however, increasing public attention had warranted treating it as a separate category despite its particularly strong interrelationships with other issues.

Part of the public sees a need to preserve old growth for its benefits to plant and wildlife habitat diversity, soil and water productivity, and its recreational and aesthetic values. Another segment of the public recommends converting the old growth stands to more vigorously growing second growth stands to support future timber production needs. The amount of the old growth to be harvested in the next decade affects the current timber supply also.

Roadless Lands

Although the Oregon Wilderness Act of 1984 resolved part of the issue concerning Wilderness, interest in some of the Willamette's roadless lands has remained high. "Wilderness" as an issue was rated highly important by the 1981 respondents. In 1983 a reinventory of the roadless lands on the Forest included extensive public involvement, including a 1200-piece mailing and a series of public meetings. The 1984 Act increased the amount of designated Wilderness on the Forest to about 25% of the land base.

The nature of this issue revolves around using these lands for timber production; or to defer harvest to preserve old growth trees, provide habitat diversity, and protect aesthetic values. A "no-harvest" allocation assigned to unroaded areas would also tend to maintain options for future designation as Wilderness. Some people feel that the marketable resources in these areas should be developed; some feel that they should remain undeveloped. Still others feel that some lands currently in a developed condition should be returned to an undeveloped condition, particularly if the lands are adjacent to designated Wilderness.

Scenic Quality

The visual quality of the Forest landscape is of concern to adjacent landowners, travelers, and Forest visitors. Many people prefer not to see evidence of timber harvesting from major highways and popular recreation areas such as trails, campgrounds, and scenic overlooks. Other people, who tend to favor utilization of Forest resources, feel that most visual effects of resource management activities are temporary, so that Visual Quality Objectives should play a reduced role in planning such activities.

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Timber Supply (Current and Future Timber Production)

The Forest annually provides the largest amount of timber production in the National Forest System. The amount of timber produced on the Forest therefore assumes some level of national as well as local importance. In addition, since the wood products industry is one of the three major components of the economy of the State of Oregon, concern has also been high for several years about the level of contribution the Forest's timber resource makes to the overall timber supply within the State, as well. In the 1981 survey current and future timber production received the highest weighted importance. Interest has not decreased since then.

Some people feel that the allowable harvest is too high, resulting in unacceptable adverse effects to other resource values. Others believe that the level of harvest should be maintained or increased to provide the raw material to help satisfy needs for wood products and to provide a stabilizing force on the economies of local communities which may be highly dependent upon the various wood products industries.

Additional components of the timber supply issue include: logging residues and firewood, harvest schedules and methods, use of herbicides and fertilizer, reforestation, and species mix, and access.

Water Quality and Quantity

Water quality received the second highest rating for issue importance in the 1981 issue development survey. The natural level of water quality on the Forest is generally quite high. Consequently, unlike many of the other issues addressed by the Forest Plan, the concern centers more on minimizing degradation than taking specific actions to enhance the resource over natural levels. Accordingly, much of the treatment given this issue can be found in the Standards and Guidelines and Monitoring sections of the documents.

Water quantity was of less concern than quality, and only slight variations between Alternatives exist. Adequate and consistent water supply for streamflow for fish habitat and domestic uses were of greatest concern.

Wildlife, Fish, and Plant Habitat

The broad issue of habitat represents a complex of concerns about the living components of the Forest. Central to the issue are matters of species survival and maintaining ecological diversity.

Concerns range from continuation of game species for hunting and fishing to preservation of reptiles and insects to threatened, endangered, and sensitive plant species. Differences of opinion arise about the extent and nature of land allocations and mitigation requirements associated with various individual, commercial, and management activities which are needed to assure adequate support for the viability and distribution of the various native species.

Issue Refinement Between The DEIS And The FEIS

The key issues did not change between the DEIS and the FEIS, but some refinements in focus occurred, most notably to five of the key issues. The attempt to be responsive to these refinements ultimately led to analysis of three new alternatives in the FEIS. The five affected key issues are identified with the same descriptors used in the preceding discussion of major issues.

Dispersed Recreation

A segment of the McKenzie River and the North Fork of the Middle Fork of the Willamette River received Wild and Scenic River designation by Congress in 1988. Congress also required that Blue River and the South Fork of the McKenzie River be studied for their suitability for Wild and Scenic River status. The State of Oregon added two additional rivers to its State Scenic Waterways inventory. Interest in studying additional rivers and their segments for similar designations has intensified.

Special designations of these types affect management practices on the rivers and surrounding lands. Timber harvest, road building, and recreation site development may be constrained or eliminated for some distance from the rivers themselves. Retaining the special values of study rivers pending suitability determination similarly affects the nature and extent of new management activities in those areas until suitability is resolved.

Old Growth

The intensification of public interest surrounding old growth has involved a number of key issues: old growth as forest structure; old growth as a reservoir of timber supply; old growth as an ecosystem providing a unique habitat in support of other plant and animal species. This discussion focuses on old growth as forest structure. Related discussions can be found in the Timber Supply and Wildlife, Fish, and Plant Habitat subsections.

One of the more perplexing aspects to addressing old growth concerns was the apparent lack of unanimity of definition. Some of the more commonly used definitions are the Region 6 definition (Regional Guide), the Pacific Northwest Range and Experiment Station definition (PNW 447), and the definitions proposed by the Wilderness Society and the Society of American Foresters. In order to enhance public understanding of old growth issues, data are analyzed and displayed in the FEIS using several different definitions.

Increased attention has focused on the silvicultural values of old growth structure, including its capability to retain and enhance soil and water productivity. This attention has not limited its scope to preservation of existing stands. Indeed, interest in old growth structure has been instrumental in the development of changing philosophies of site utilization and stand regeneration techniques, known as "the New Forestry" and "New Perspectives Forestry."

Differences in public and professional opinion exist about the extent to which increased preservation of old growth and "New Perspectives" forestry should occur; the specific nature of indicated practices; the best locations in which to undertake the practices; and the attendant risks involved, such as susceptibility to fire and disease.

Timber Supply

The Timber Supply issue intensified to near-crisis proportions during the period between the DEIS and the FEIS. Although the values of harvested timber on the Forest reached all-time highs, the volume sold for eventual harvest dramatically reduced by fiscal year 1989. Much of the reduction in sold volume was in response to court injunctions associated with spotted owl habitat litigation. The current and intermediate term availability of timber from all sources within the State of Oregon achieved high levels of public concern. Central to this concern was the contribution made by the federal sector, particularly in the form of old growth timber.

Ultimately Congress balanced the habitat needs of the spotted owl with the federal supply needs of old growth dependent mills by passing the Northwest Timber Compromise as Section 318 of the Fiscal

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Year 1990 Appropriations Act. This legislation was acknowledged not to represent a permanent solution, however. Consequently, the public issues remain for evaluation under the planning process.

In addition, many public comments alerted the Forest to improvements which could be made to the technical analysis of timber availability.

Water Quality and Quantity

Public comments during the response period after publication of the DEIS sent the strong message that many of the alternatives in the DEIS, including the preferred alternative, proposed unacceptable levels of watershed degradation. This did not so much represent a refinement of public concern as it represented a reaffirmation of the intensity with which the concern was held and the need for the Forest to address the issue with greater sensitivity.

Wildlife, Fish, and Plant Habitat

During the interval between the DEIS and FEIS, concerns surrounding plant and animal diversity and habitat preservation intensified. These concerns spanned a wide variety of species, habitats, and management practices. The most notable representatives of these concerns were spotted owl habitat, old growth as a reservoir of a unique and valuable ecosystem, and riparian areas as critical ecosystems.

These issues were central to examining notions such as habitat connectivity and preserving options. In many cases, however, decisions to provide or enhance such connectivity or to preserve options produce reductions in timber supply or suggest relatively more costly harvest techniques.

Disposition Of The Issues

The initial planning concerns, as well as the seven key issues, are discussed in several places throughout the FEIS and in the Final Forest Plan. Figure A-B-1 indicates the chapters in the documents which address the issues. The Alternatives displayed in the FEIS differ primarily in the way they respond to the planning issues. Figure A-B-2 lists the "indicators of responsiveness" which are used to show a quantified level of response. Figure II-E-29 displays the Alternatives' outputs and effects, listed by the key issues.

Table T148. Disposition of Forest Issues (Figure A-B-1)

Planning Concern (Appendix A)	Plan Issue (Chapter 1) (FEIS)	Alternatives (Chapter 2) (FEIS)	Consequences (Chapter 4) (FEIS)	Standards and Guidelines (Forest Plan)
Dispersed Recreation	Yes	Vary by Acres & Management	Yes	Yes
Developed Recreation	No	Vary by Sites	Yes	Yes
Wilderness (combined) ¹	No	One Area Variable	Yes	Yes
Visual/Scenic	Yes	Vary by Acres VQO	Yes	Yes
Cultural Resources	No	Inventory Acres & Type	Yes	Yes
Wildlife and Plant Habitat	Yes	Vary by Acres & Type	Yes	Yes
Aquatic Habitat (combined) ¹	No	Vary by Acres	Yes	Yes
Livestock Grazing (Range)	No	Vary by AUMs	Yes	Yes
Timber	Yes	Vary by Acres & 1st Decade ASQ	Yes	Yes
Logging Residues (combined) ¹	No	Firewood: Vary by MCords	Yes	Yes
Water Quality; Water Quantity	Yes	Vary by Risk Level; Acre/Feet	Yes	Yes
Air Quality (combined) ¹	No	--	Yes	Yes
Minerals	No	Entry Acres Available	Yes	Yes
Energy	No	Entry Acres Available	Yes	Yes
Individual Well-being	No	--	Yes	No
Local Economics	No	Jobs; Income; Revenue	Yes	No
Old-Growth	Yes	Vary by Acres	Yes	Yes
Roadless Lands	Yes	Vary by Acre & Areas	Yes	No
Economic Efficiency	No	Present Net Value	Yes	No

¹The facets of this issue have been incorporated into another related issue and information on the topic may be tracked throughout the FEIS (see Index).

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Table T149. Indicators of Responsiveness (Figure A-B-2)

ISSUE/Indicator	Unit of Measure
DISPERSED RECREATION	
Lands Allocated to Semiprimitive - Nonmotorized	Thousand Acres
Lands Allocated to Semiprimitive - Motorized	Thousand Acres
Lands Allocated to Special Interest Areas	Thousand Acres
Lands Allocated to Old-Growth Groves	Thousand Acres
Trail Construction in the 1st Decade	Miles
OLD-GROWTH	
Amount of Old-Growth Timber Retained	Thousand Acres
ROADLESS LANDS	
Roadless Acres Left Undeveloped	Thousand Acres
SCENIC QUALITY	
Lands Allocated to a Retention VQO	Thousand Acres
Lands Allocated to a Partial Retention VQO	Thousand Acres
Lands Allocated to a Modification VQO	Thousand Acres
TIMBER SUPPLY	
Allowable Sale Quantity in the 1st Decade	Million Board Feet
Allowable Sale Quantity in the 1st Decade	Million Cubic Feet
Long-Term Sustained Yield	Million Cubic Feet
WATER (Quality and Stream Condition)	
Area with Risk of Adverse Impact Rating (Low, Medium, & High) ¹	Percent in each Rating

ISSUES, CONCERNS, AND OPPORTUNITIES

ISSUE/Indicator	Unit of Measure
WILDLIFE, FISH, AND PLANT HABITAT	
Habitat Capability for Spotted Owls (Mature/old-growth habitat)	Acres of Habitat Maintained
Habitat Capability for Pileated Woodpecker (Mature/old-growth habitat)	Acres of Habitat Maintained
Habitat Capability for Pine Marten (Mature/old-growth habitat)	Acres of Habitat Maintained
Habitat Capability for Elk (End of 1st Decade)	Ratio Between Percent of High, Medium, Low Emphasis
Habitat Capability for Deer (End of 1st Decade)	Ratio between Percent of High, Medium, Low Emphasis
Special and Unique Habitats	Acres Protected
Bald Eagle Recovery	Number of BEMAs; Acres of Nesting Habitat
Peregrine Falcon Recovery	Number of Potential Nesting Cliffs
Cavity Nesting Habitat	Percent Potential Population Managing for
ECONOMICS	
Changes in Numbers of Jobs in 1st Decade	Number of Jobs
Changes in Income in the 1st Decade	Millions of Dollars
Payments to Counties in the 1st Decade	Millions of Dollars
Net Cash Flows in the 1st Decade	Millions of Dollars
Present Net Value for 15 Decades	Billions of Dollars

¹See Chapter IV, Water, for further explanation.

CONSULTATION WITH OTHERS

The size and scope of the Willamette National Forest and its location near large municipal centers in the Willamette Valley led to a high level of continuous public contact. Although the discussion below makes no attempt to be exhaustive, it describes many of the organizational contacts which were made in the development of the FEIS and Final Forest Plan. Readers specifically interested in the public comments after publication of the DEIS should read Appendix I.

Agencies And Groups

The Forest worked closely with a number of governmental entities holding special expertise in many diverse disciplines touching forest management. For instance, neighboring National Forests were consulted, particularly on matters of mutual concern where a measure of relative consistency in management treatment of forest resources were desirable. The Environmental Protection Agency, Bureau of Land Management, and the U.S. Fish and Wildlife Service are examples of other federal agencies which were consulted.

Counterpart agencies for the State of Oregon were also consulted, in particular the Oregon Department of Fish and Wildlife, the Oregon State Department of Forestry, the Oregon Department of Environmental Quality, and the Governor's National Forest Planning Team. Consideration was given to the "Forestry Program for Oregon" during alternative development.

Planning documents of various federal and State agencies were available in order to coordinate management where appropriate. County plans for Lane, Linn, Douglas, and Marion counties were reviewed.

Numerous consultations with elected officials of federal, State, and local jurisdictions, or their staff, yielded valuable information about the concerns of their constituencies and provided insight into the major issues surrounding the future management of this Forest. In many instances these consultations included tours and field trips, allowing discussions to be specific.

A series of meetings were held in January and February 1985 to provide an opportunity for participation in the development of resource management options for Alternative formulation. Many of the same individuals and groups that responded during the initial issue development process stayed with the process the entire time. In addition to formally scheduled public involvement activities, the Willamette encouraged continual involvement from groups expressing special interest in the management of Forest resources.

The Oregon Natural Resources Council (formerly Oregon Wilderness Coalition) and its member groups which use the Forest have been active in the Plan's development since 1980, submitting narrative and mapped proposals for land allocations. Some other especially active groups tending to emphasize noncommodity uses of the Forest include the Chemeketans, Old Cascades Wilderness Committee, Waldo Wilderness Council, Cathedral Forest Action Group, Hardesty-Mt. June Council, and Cascade Holistic Economic Consultants. The Mt. Jefferson Snowmobile Club, Oregon Trout, American Alpine Club, Obsidians, Sierra Club, and others have also been involved. Site specific concerns were recorded on a data base map and evaluated during Alternative formulation.

The Forest has also worked with "consensus groups" composed of members of the public and agency representatives to develop management proposals to be analyzed during this round of planning for

several locations on the Forest: Fall Creek, Hardesty Mountain, South Fork of the McKenzie, and Three Creeks.

In the interval between the DEIS and FEIS, the Forest also received valuable advice from a group known as the "Fruitful Discussions Group." This group was comprised of a number of representatives from the environmental community, timber industry, and local government who regularly met to provide advice to the Forest Supervisor in the development of the Forest Plan. While the members of the group recognized that their individual organizational goals frequently differed considerably, the Fruitful Discussions Group worked hard to develop a common understanding of specific issues affecting forest planning and to produce consensus recommendations on those matters where agreement could be reached. Given the range of informed opinion this group represented, the Forest found the group's recommendations very useful in clarifying the issues and narrowing the scope of topics of key concern.

Adjacent landowners and land managers were also included in public involvement activities. Summer homeowners also commented. The Breitenbush Community, Shiny Rock Mining Corporation, and the Willamette Pass Ski Area Corporation contributed input.

The primary industry which was represented during the planning effort was the timber industry, since raw material for wood products is the main commercial commodity available from the Forest. The Associated Oregon Loggers, Industrial Forestry Association, Northwest Timber Association, Western Timber Association, Willamette Timbermen, Oregon Women for Timber, and others have been continually involved. Individual mills and companies have also been represented.

Indian Tribes

There are four Indian Reservations in the vicinity of the Forest. They include the Confederated Tribes of the Warm Springs Reservation, the Cow Creek Band of Umpqua Indians, the Confederated Tribes of Siletz Indians, and tribes of Confederated Grand Ronde Indians. Letters were sent to the tribal council of each respective tribe to inform them that the Forest was preparing a new land management plan. The Forest encouraged participation in the planning process. A letter of this nature was also sent to the Bureau of Indian Affairs, Portland, Oregon.

Through the Willamette Cultural Resource Management Program, the Forest solicited input from the nearby tribes and the Bureau of Indian Affairs. Requested were their issues and concerns related to the Forest, areas on the Forest where the Indian tribes have had historic use, and the magnitude of that use. Historic use can include hunting, fishing, gathering, religious practices, or any other culturally sensitive activity.

An early consultation with Indian tribes in the Pacific Northwest was a series of coordinated meetings held by the Regional Forester in Seattle on November 10, 1981, and other selected locations and dates throughout the Region. Indian concerns generated at these meetings were forwarded to the Forest and incorporated into the planning process. Issues resulting from this interaction included: knowledge of and responsiveness to Native American treaty rights on Forest Service administered lands; responsiveness to cultural resource management laws and regulations including the American Indian Religious Freedoms Act; access to Forest resources for traditional uses and activities, including hunting, fishing, grazing, and gathering; the compatibility of maintaining traditional Indian culture and religion with Forest Management programs; and building an atmosphere of trust between Native American leaders, their representatives (including attorneys, planners, and biologists), and Federal agencies.

ISSUES, CONCERNS, AND OPPORTUNITIES

The Forest, along with other Columbia Basin Forests in the Region contributed to a joint response to the Columbia River Intertribal Fisheries Commission, which requested data on anadromous fish production and habitat. The Columbia River Intertribal Fisheries Commission consists of representatives from the Yakima Indian Nation, Warm Springs Confederated Tribes, Nez Perce Indian Nation, and the Umatilla Confederated Tribes. The Willamette River, which drains the Forest, is confluent with the Columbia River below the Bonneville Dam; fisheries production from the Forest was not as large a concern to the Columbia River Intertribal Fisheries Commission as upper Columbia River fisheries issues.

Representatives from the Forest attended a conference in May 1986 entitled "Perspectives on the American Indian Cultural Heritage: Indians, Historians, and Archaeologists." The conference discussed important issues and concerns from Native Americans about the Cultural Resource Management Program. Issues included the working relationship between archaeologists and the Native American community, the importance of Native American historical and archaeological knowledge to Native Americans, the process the USDA Forest Service implements in the cultural site testing program, the treatment of burial sites, sacred sites and remains, religious sites, and respect and regard for American Indian values and interests.

No Indian burial sites have been found on the Forest. The Forest has worked with the Confederated Tribes of the Grand Ronde Indians to obtain input and involvement in the site testing program to determine the extent and nature of their use of lands on the Forest. In addition, Native Americans at the Native American Student Union on the University of Oregon campus and individuals in the community expressed a desire to establish a sweat lodge for religious practices on the Forest.

Native American Cultural Awareness Days in June 1986 and August 1987 provided a forum for the Confederated Tribes of Siletz Indians, the Native American Special Emphasis Program Coordinator on the Willamette National Forest, and Native American employees on the Forest to present Native American issues, culture, and art.

Informal meetings have occurred at various levels with Native American Tribes and the Forest Service. Site specific issues and concerns have been discussed at the Forest and Ranger District level with Warm Springs Confederated Tribe representatives. A portion of the Mt. Jefferson Wilderness on the Detroit Ranger District borders the Warm Springs Indian Reservation. Annually, Forest Service Wilderness guards and Tribal law enforcement officers meet informally. Trespass onto the Reservation by Forest hikers and commercial operators has surfaced as a concern. Coordination and pursuit of a cooperative management effort in the area is continuing.

Comments Received

The following is a nonexhaustive list of groups with whom the Forest met or from whom the Forest received written comments during the planning process:

Federal

- Northwest Power Planning Council
- U.S. Army Corps of Engineers
- U.S. Congress - Representative Peter Defazio
- U.S. Congress - Representative Denny Smith
- U.S. Department of Energy - Bonneville Power Administration
- U.S. Department of Interior - Bureau of Land Management

ISSUES, CONCERNS, AND OPPORTUNITIES

U.S. Department of Interior - Fish and Wildlife Service
U.S. Environmental Protection Agency
U.S. Senate - Senator Bob Packwood
U.S. Senate - Senator Mark Hatfield

ISSUES, CONCERNS, AND OPPORTUNITIES

State of Oregon

Department of Energy
Department of Geology and Mineral Industry
Department of Fish and Wildlife
Department of Forestry
Department of Transportation
Land Conservation and Development Commission
Office of the Governor
State Economist

County

Lane County
Linn County
Marion County

City

Detroit
Eugene
Gates
Mill City
Oakridge and Westfir
Salem
Springfield

Companies and Organizations

American Alpine Club
Associated Oregon Loggers
Atlantic Richfield
Bohemia, Inc.
Breitenbush Community
Cascade Holistic Economic Consultants
Cathedral Forest Action Group
Central Electric Cooperative
Chemeketans
Eugene Chamber of Commerce
Eugene Water and Electric Board
Friends of the Earth
Fruitful Discussions Group
Hardesty Mountain Consensus Group
Hardesty - June
Industrial Forestry Association
McKenzie Flyfishers
McKenzie Guardians
McKenzie Wild and Scenic River
Middle Santiam Wilderness Committee
National Wildlife Federation
Native Plant Society of Oregon

North Cascades Conservation Council
Northwest Off-Road Bicycle Association
Northwest Outward Bound School
Northwest Pine Association
Northwest Timber Association
Obsidians
Old Cascades Wilderness Committee
Oregon Equestrians
Oregon Natural Resources Council
Oregon Trout
Oregon Wildlife Federation
Oregon Women for Timber
Oregonians for the Protection of Ecological Quality
Save the North Fork Group
Shiny Rock Mining Company
Sierra Club, Northwest Office
Sierra Club, Many Rivers Group
Sierra Club, Portland, Bend, Seattle, Spokane, and Idaho
South Fork McKenzie River Corridor Task Group
The Wilderness Society
Towne Club
Umpqua Wilderness Defenders
Waldo Wilderness Council
Washington Wildlife Coalition
Western Industrial Foresters Association
Western Timber Association
Willamette Industries
Willamette National Forest Summer Home Owners
Willamette Timbermen

ISSUES, CONCERNS, AND OPPORTUNITIES

APPENDIX B

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APPENDIX B

DESCRIPTION OF THE ANALYSIS PROCESS

INTRODUCTION

Planning Situation

One of the primary responsibilities and challenges facing the Forest Service is deciding how best to manage National Forest lands to produce the goods and service desired by the public. Because National Forest lands and the resources they contain are valued by society, commitments to various uses represent significant decisions with far-reaching implications for current and future users.

The NFMA of 1976 (NFMA) directs each National Forest to prepare a comprehensive land management plan. The Forest's major planning goal under NFMA is to provide decision makers with sufficient information to determine the mix of goods, services and land allocations which best resolves the identified public issues in a manner that maximizes net public benefits. Net public benefits are defined as the overall long-term value to the Nation of all outputs and positive effects (benefits), less all associated inputs and negative effects (costs), whether they can be quantitatively valued or not.

The regulations (36 CFR 219) developed under NFMA provide the analytical framework for developing a forest plan. The National Forest Management Act and its regulations also state that the requirements of the National Environmental Policy Act (NEPA) and its regulations (40 CFR 1500-1508) must be applied in this analysis process. The NEPA regulations require that the environmental effects of a proposed action and alternatives to that proposed action must be disclosed in an Environmental Impact Statement (EIS).

The planning problem is a very complex one. This complexity stems from the need to address a variety of interrelated and often conflicting issues by allocating land and scheduling activities in a cost-efficient manner for the entire Forest over a long period of time. The analytical processes and techniques used by the Forest to accomplish this are described in this Appendix.

Changes Between Draft and Final

Based on public comment the estimated effects (Step #6 below), the evaluation of alternatives (Step #7), the preferred alternative recommendation (Step #8) and even some of the formulation of alternatives (Step #5) have been revised for the FEIS. In this Appendix you will find many areas where the analysis process has changed. As you review the analysis process you will find new descriptions under the following topics.

INTRODUCTION

Inventory & Data

- Timber inventory condition classes (updated for harvest)
- Timber age class stratification (young stands and large sawlogs/old growth disaggregated)
- Fertilizer response (increased)
- Spotted Owl inventory data (updated)
- Other mature conifer habitat allocations (modified)
- Soil resource inventory interpretation (corrected)
- Wild & Scenic Rivers (included)

Modeling Assumptions

- Analysis area stratification (revised)
- Allocation zones (moved to analysis areas)
- Limited entry areas (visuals, dispersed recreation, and some riparian) modeled outside FORPLAN
- Technical FORPLAN design (changed)
- IMPLAN model (updated)
- Wildlife, recreation and water quality models (changed)
- Breakage, defect and dead tree habitat factors (revised)
- Relational data base operations (added)

Management Changes

- Allowable sale quantity (salvable dead timber included)
- Alternatives considered in detail (changed)
- Timber prescription set (changed)

The Planning Process

The planning process described in the NFMA regulations consists of ten steps oriented towards a systematic analysis of the complex problems associated with multiple-use forest management. This 10-step process is discussed in Chapter I of the DEIS and is briefly summarized as follows:

1. Identification of purpose and need: Issues, Concerns, and Opportunities (ICO's) - In any systematic approach to problem solving, the first step is to identify the problem. In this step, the interdisciplinary Team (IDT) identifies and evaluates public issues, management concerns, and resource use and development opportunities. What does the public want? What does the Forest Service want? What needs to be done?
2. Planning Criteria - Criteria are designed to guide the collection and use of inventory data and information, the analysis of the management situation and the design, formulation, and evaluation of alternatives. This step sets the guidelines for accomplishing the next 5 steps.
3. Inventory data and information collection - The type of data and information needed is determined in step 2 based on the ICO's. The data is then collected and assembled in a manner meaningful for answering planning problems.
4. Analysis of the management situation - This step is a determination of the ability of the planning area to supply goods and services in response to society's demands. This provides a basis for formulating a broad range of reasonable alternatives.

5. Formulation of alternatives - A broad range of reasonable alternatives is formulated according to NEPA procedures. Alternatives are formulated in a manner which provide an adequate basis for identifying the one that comes nearest to maximizing net public benefits.
6. Estimated effects of alternatives - The physical, biological, economic and social effects of implementing each alternative considered in detail are estimated and compared according to NEPA procedures.
7. Evaluation of alternatives - Significant physical, biological, economic and social effects of implementing alternatives are evaluated with respect to the planning criteria.
8. Preferred alternative recommendation - The Forest Supervisor reviews the IDT's evaluation and recommends a preferred alternative to the Regional Forester who then selects one from the group that is provided. This is identified in the Draft Environmental Impact Statement and displayed as the proposed plan.
9. Plan approval and implementation - The Regional Forester reviews the proposed plan and Final Environmental Impact Statement and either approves or disapproves the plan.
10. Monitoring and evaluation - The plan establishes a system of monitoring at established intervals to determine how well objectives have been met and how closely management standards and guidelines have been followed. Based on these evaluations, the plan will be revised or amended as necessary.

Three distinct phases occur during this process. Planning steps 1, 2, 7, and 8 make up the judgmental or selection phase of the process. These steps are addressed in Chapters I, II, IV and in Appendix A of the DEIS. Steps 9 and 10 are execution steps and are dealt with in or through the proposed Forest Plan. Steps 3, 4, 5 and 6 are analytical steps and are addressed along with other details of the analysis in this Appendix.

INVENTORY DATA AND INFORMATION COLLECTION

Overview

The inventory step in the planning process consists of the collection, development, automation and documentation of data and information needed to address the ICOs and planning criteria identified in Planning Steps 1 and 2. Two basic types of information are needed to facilitate the analysis and development of alternatives. The first consists of information related to the classification of land into categories with unique properties. This classification can be based on land form, existing resources, production capabilities, political or other geographic boundaries, or some other attribute or combination of attributes. This type of information is directly tied to a map base, and to facilitate analysis of the size and complexity of forest planning, is usually handled by a computerized mapping system.

The second type of information is not tied directly to a map but has to do more with how the land responds to various activities applied to it. On a specific piece of ground, management activities and their associated costs result in the production of physical outputs and effects (i.e. yields) and some associated economic benefits and costs. To evaluate the planning problem, physical and economic yields and relationships are developed based on a potential set of management activities or prescriptions which can be applied to land with similar characteristics. This data comes from a variety of sources,

INVENTORY DATA AND INFORMATION COLLECTION

most of which are listed in the last part of this section. The rest of this section will discuss the mapping Data Base and some of the major uses of the vast amount of information assembled for the Land Management Planning process.

Data Base Development

The Forest considered use of several different automated data bases for storage and retrieval of geographic planning information. A grid mapping system, the Mt. Hood National Forest's version of R2MAP, was set up on the University of Oregon's computer and eventually transferred to the Forest's Data General computer system.

After selecting a mapping system, determining an appropriate grid cell size and map scale was necessary to initiate Data Base construction. A one inch to the mile scale was considered appropriate for Forest-wide planning because of the large size of the Forest and much information was already developed at that scale. The size of a grid cell is a function of the size of the two line printer characters used to represent the resource data mapped for that cell. A rectangular cell 1/5-inch by 1/6-inch accommodates two line printer characters. This represents 21.33 acres of land at the one inch to a mile scale.

A grid mapping system organizes the resource data into "layers" of information. This information can be overlaid in different orders and combinations to see the coincidence, correlations, and associations of the various resources for specific locations. The overlay technique provides a unique opportunity for analyzing data. It allows many types of information to be examined simultaneously and in different combinations. It also allows information to be manipulated quickly and accurately. The system accurately tallies acreages and locates those acres spatially.

Some types of information, however, can not be represented well in this mapping system. The 21.33 acre grid cell size makes linear (roads and streams) and small area information (administrative sites) hard to represent. Any spatial representation of these types of information distorts the acreage and a decision has to be made whether acreage or location is the most critical factor. For display maps the location is generally taken as the most critical factor but for analysis maps correct acreage summaries control the decisions.

Using the mapping system for planning influences the form in which data is needed. It also influences the level of resolution, detail and accuracy of the data actually used in planning. Some types of data lend themselves to this format better than others. But the limitations implicit in this are outweighed by the benefit of having all the information in a consistent, easily-used format so that all of it can be considered throughout the analysis and planning process.

The selection of layers to include in the mapping system was based on several factors. The major need for forest planning was the ability to combine basic resource data and geographic locations into analysis areas, and relate those acreages to potential land allocations. Other layers were included to assist in the calculation of costs, yields, effects, conditions, constraint values or acreage adjustments. Table B-1 lists the data layers in the mapping system. The last part of this section summarizes the major data sources for layers in the Forest's Data Base and other types of information used in Forest planning. Additional information on the Forest's Data Base is contained in the paper "Data Base Documentation" which is available in the Forest's planning records.

Toward the end of 1989 the Forest put the "MOSS" Geographic Information System (GIS) on its Data General computer system. Information on the management strategies and "Mature/OverMature Status" inventory were combined in the MOSS system to analyze old growth protection in the FEIS.

Table B-1. Mapping System Data Layers

SOILS Soils Unsited Soils WATER Watersheds Riparian TIMBER Timber Size Timber Type Timber Update Commercial Thinning Aerial Logging WILDLIFE Spotted Owl (SOMA) Winter Range Pileated Woodpecker Pine Marten Special Wildlife Areas THREATENED & ENDANGERED SPECIES Bald Eagle (BEMA) T&E Plants VISUAL Visual Absorption Capability (VAC) Slope Viewsheds Existing Visual Condition (EVC) Visual Quality Objectives (VQO)	ENGINEERING Transportation Rock Sources Minerals BOUNDARIES/LAND MANAGEMENT/ENCUMBRANCES Ownership Administrative Boundaries Wilderness Research Natural Areas (RNA) Roadless Areas O&C Lands/Stipulated Mining Claims Land Management Plan (LMP) Special Uses/Administrative Sites Special Interest Areas/National Natural Landmarks/Wild and Scenic Rivers Geothermal Oil & Gas Leases/Hydroelectric Sites OTHER Cultural Resources Transitory Range RECREATION Developed Recreation Sites Potential Developed Recreation Site ROS Physical (Recreation Opportunity Spectrum) Trails WROS (Wilderness ROS)
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Major uses of Inventory Data

Analysis Areas and Allocation Zones

The basic resource information and boundaries contained in the data layers of the mapping system are used to define the areas which are analyzed in the planning process. For the Forest, two levels of resource information were needed to adequately represent the planning problem: analysis areas and allocation zones.

Analysis areas represent aggregations of many individual areas which have similar characteristics and respond to management practices and activities in similar ways. The composition of an analysis area is important because it defines the range of management activities appropriate for a given objective and the resultant costs and yields. The analysis model FORPLAN assigns prescription to analysis areas based upon these costs and yields.

Analysis areas are constructed by overlaying several resource layers in the mapping system. These layers or combinations of layers become analysis area identifiers.

Overlaying all of the resources and boundary layers in the mapping system would result in tens of thousands of unique areas. Modeling limitations in FORPLAN require some grouping or condensing to arrive at a manageable number of analysis areas. In the DEIS model, allocation zones (watersheds) were used in concert with forest-wide analysis areas. For the FEIS, the watersheds were included in the analysis area identifiers; but big game winter range, slope class, soil stability and logging suitability were taken out of the analysis areas used by FORPLAN. Where these data were needed, they were included in the information provided to a side model or averaged across the watershed. *The Forest Planning Model* later in Appendix B contains more information on the development and composition of the analysis areas.

Production Coefficients

Analysis of the planning problem requires the development of production functions which are relationships between sets of inputs (i.e., activities and their costs) and outputs, effects, and conditions. The coefficients which represent these relationships were developed in a number of ways and from a variety of sources. In some cases, data representing several years experience were averaged. In other situations, historical data were not available or representative of anticipated practices, so estimates were made.

Computerized models were used to develop certain types of yields (e.g., timber yields from DP-DFSIM and PROGNOSIS). The Forest's grid mapping system (Mt. Hood version of R2MAP) aided in the construction of production coefficients in some cases by providing the acreages of specific categories within other more general categories. The derivation of production coefficients is discussed in more detail later in Appendix B in the Forest Planning Model section titled *Development of Yield Coefficients* and the *Economic Efficiency Analysis* section.

Timber Suitability

The Forest followed a process based on National and Regional direction to determine which lands are unsuitable for timber management. This process included a screen for regeneration difficulty. The Forest's soil resource inventory (SRI) was used to locate areas with potential regeneration difficulty. Unsuitable soils became a layer in the Forest's Data Base and were used in defining analysis areas. A data base error was identified in the DEIS interpretation of the Soil Resource Inventory. Correcting the error for the FEIS analysis resulted in the addition of approximately 29,000 acres to the lands tentatively suitable for timber production. The Timber suitability process and results are presented in the FEIS, Chapter III.

Alternative Development and Analysis

Alternatives were developed to meet specific resource objectives or to follow a particular theme. The basic use of inventory data in this step was to accurately reflect the land base and provide the basis for scheduling activities and estimating outputs, costs and effects through the development of production coefficients. Inventories of potential land allocations or management areas were used as a basis for assigning prescriptions in each alternative. The Forest's Data Base greatly facilitated the task of identifying these areas and determining which prescriptions could be applied. This process is described more fully later in Appendix B, in the sections titled *The Forest Planning Model*, and *Formulation of Alternatives*.

Implementation and Monitoring

Inventory data will continue to be essential when the plan moves into the implementation and monitoring phases. Site-specific activities and projects will be scheduled based on the results of the Forest-wide planning process. Changes in the land base due to timber harvest, Congressional mandates and other major developments will guide future activity scheduling. Data collected to monitor activities and their effects will be stored to facilitate mid-course corrections and future analyses. More detail on these steps can be found in Chapter 5 of the Forest Plan.

Summary of Major Data Sources

Major data sources used in the planning process are divided according to mapping system data layers (Table B-1) and coefficient development/estimation of effects.

Mapping System Data Layers

1. The basic **soils** map was developed from the Forest's *Soil Resource Inventory* (SRI) which was conducted in 1971-72 and published in 1973.
2. **Unsuited soils** were identified in a Timberland Suitability study by the Forest's Soil Scientist in 1980 and revised in 1984.
3. Watershed **subdrainage boundaries** were mapped in 1980-81 by District personnel.
4. **Riparian zones** were identified from a "Stream Classification Map" developed in 1972 and revised in 1979.
5. The Forest's most recent **Timber inventory** (1981), subsequent updates (1984 and 1988) and analyses provided the Timber size and type information needed to describe the Forest's timbered vegetation.
6. **Commercial thinning accessibility** information was developed from 1982 topographic maps with updated road information from the transportation planners and Districts. The original mapping was done in 1982 and revised in 1984.
7. **Aerial logging** areas (inaccessible by ground based logging systems) were mapped by District timber staffs in 1982 and revised in 1983.
8. **Spotted Owl Habitat Areas** (SOHAs), each containing a verified pair of owls, have been identified in an on-going field inventory begun in 1979. The distribution and size of the areas has changed several times. For the FEIS a 1500 acre/pair network was developed in 1989.
9. **Winter range boundaries** for deer and elk were provided by District biologists from TRI information adjusted with field knowledge in 1982. The original boundaries in TRI were mapped in 1972 by the Forest Wildlife Biologist. (Updated with District biologists and Oregon Department of Fish and Wildlife input, 1989.)
10. **Pileated woodpecker and pine marten habitat areas** were mapped by the planning team wildlife biologist based on Regional Office direction which specified size, distributional and other habitat requirements. (Updated, 1989)

INVENTORY DATA AND INFORMATION COLLECTION

11. **Special wildlife habitat areas** were mapped by District wildlife biologists in 1983. (Updated, 1989)
12. Two existing **bald eagle territories** were mapped as a Threatened and Endangered Species habitat. Potential sites were mapped based on Regional Office criteria contained in a February 9, 1983 memo.
13. **Threatened, Endangered and Sensitive plants** on the Region 6 Sensitive Plant List were mapped based on 1979 and 1980 field inventories.
14. The ability of the Forest to absorb visual change, known as the **Visual Absorption Capability (VAC)**, was mapped by the Forest Landscape Architect in 1980.
15. The **slope** map of the Forest was done by the Forest Landscape Architect in 1980 using topographic maps.
16. The VIEWIT Seen Area Program was used by the Forest Landscape Architect to develop **viewshed boundaries** along ten designated highways.
17. The **Existing Visual Condition (EVC)** inventory map which shows the appearance of the Forest at a particular point in time was developed from field inventories and the mapping system in 1984. (Updated, 1989)
18. **Visual Quality Objectives (VQO)** information was extracted from a map containing Composite Visual Quality Standards which were developed through a visual resource inventory in 1974.
19. **Existing developed recreation sites** were mapped based on information in the Recreation Information Management (RIM) System and reviewed and updated by District personnel in 1982 through 1984. (Updated, 1989)
20. **Potential developed recreation sites** were mapped based on information provided by the Districts including the number and kind of sites and size of development. (Updated, 1989)
21. The **types of recreation opportunities** available are described in terms of physical, social and managerial settings in the Recreation Opportunity Spectrum (ROS) System and are based on District inventories conducted in 1981. (Updated, 1989)
22. Mapping of **Wilderness Recreation Opportunity Spectrum** areas was done at a 1983 workshop with District personnel.
23. Transportation planners on the Forest provided information on **transportation collectorshed boundaries** in 1982.
24. **Rock sources for road building** were identified on maps prepared by geotechnical engineers on each Engineering Zone in 1981.
25. Known **mineral resources** on the Forest were obtained from the "Mineral Resource Map of Oregon", a 1984 publication by M. L. Fernes and D. F. Huber.
26. **Land ownership** within the National Forest boundaries was mapped in 1981 based on information in the *Land Status Atlas* and *Land Areas of the National Forest System*.

27. **Administrative boundaries** were also obtained from the two documents listed under land ownership as well as information contained in "Forest Facts, 1980" and Congressional Districts Map (1982).
28. **Wilderness boundaries** were obtained through inventory mapping in 1981 and revised to reflect the additions from the 1984 Oregon Wilderness Act.
29. The boundaries for established and proposed **Research Natural Areas (RNAs)** were taken from the existing Willamette National Forest Land Management Plan (1977) and mapped in 1981. (Updated, 1989)
30. All **roadless areas** identified in Forest plans and RARE II were mapped. Other areas that appeared to meet roadless criteria were also mapped in 1981. All roadless area boundaries were adjusted in 1984 to account for the 1984 Wilderness Act and an additional update was conducted in 1989 to reflect continuing road building and timber sales.
31. The boundaries for **Oregon and California (O&C) Grant Lands, stipulated mining claims, administrative sites and special use permits** were derived from the *Land Status Atlas*. The *Land Use Reporting System* (LUR) and special use permit files were also used as information sources for mapping special use boundaries.
32. The **current Land Management Plan** (1977) was mapped with periodic revisions to reflect allocation and acreage adjustments to the present.
33. **Special Interest Areas, National Natural Landmarks and Wild & Scenic Rivers** were mapped by the planning team in 1983-84 using information from the National Park Service, the Forest's current Land Management Plan, and District and staff input. (Updated, 1989)
34. Information about the known **geothermal resource** was provided by the Lands and Minerals Staff, mapped in 1981 and updated in 1984.
35. The *Land Status Atlas* provided information on **existing hydroelectric sites. Oil and gas lease areas** were obtained from descriptions in applications provided by the Lands and Minerals Staff in 1984.
36. **Prehistoric and historic cultural sites** were mapped in 1982 and updated in 1989.
37. **Trail system** information was obtained from the Trail System Inventory updated by District personnel. (Updated, 1989)

Coefficient Development/Estimation of Effects

1. Codes and definitions for most activities, outputs and effects come from the Forest Service's National Activity Structure Handbook (FSH 1309.16).
2. Timber values were obtained from the Timber Sale Statement of Accounts Data Base and represent the value of Timber harvested from April, 1977 through September, 1983.
3. Other resource values are taken from the 1985 Forest and Rangeland Renewable Resources Planning Act (RPA) Program Update per Regional Office direction (1920 letter of April 27, 1984) and FSM 1971.64.

INVENTORY DATA AND INFORMATION COLLECTION

4. Cost information was developed from multi-year averages of actual expenditure data from the PAMARS Data Base, submission to the 1985 RPA Program Update, and Staff or specialist estimates.
5. Existing stand timber yield tables were developed from volume and growth information by species from the 1981 Forest timber inventory.
6. Managed stand timber yield tables were developed using two growth and yield models: Dynamic Programming Douglas-fir Simulator (DP-DFSIM) for low elevation species and PROGNOSIS for high elevation species.
7. Salvable dead volume coefficients were obtained from the 1981 timber inventory.
8. Percentage increases for volumes (in addition to net green) available from natural stands were developed from Cut and Sold Reports (e.g., nonchargeable cull and other convertible products) and the Timber Inventory Adjustment Record (e.g., chargeable dead salvage and unregulated).
9. Dispersed recreation capacity coefficients were estimated by Recreation Opportunity Spectrum (ROS) class based on the procedures outlined in the ROS Users Guide (FSH 2309.13).
10. Wilderness capacity coefficients were developed through the use of WRS class standards, Wilderness specific data, and limits of acceptable change (LAC) considerations.
11. The RIM System provided the information needed to determine developed site capacity estimates and was the basis for making recreational use projections for all sites and areas on the Forest by alternative.
12. Social and Economic Statistics and a description of the local economy were obtained from the Forest's Socio-Economic Overview and updated with current figures from the State of Oregon, Employment Division.
13. National and county data files describing local county economies and inter-industry transactions that occur as goods are produced and sold formed the base data used by the input-output model IMPLAN which predicts local economic impacts of alternatives.
14. Road construction rates were developed through computer analyses which generate roading estimates based on variable harvest rates associated with the amount of land available and suited for timber production in each watershed, roadless area, and management area.
15. Erosion production rates based on Willamette National Forest SRI types were developed through a study contracted to the Pacific Northwest Forest Research Station. These rates were then converted to erosion coefficients specific to slope and soil stability classes for use in the planning model.
16. Wildlife and Fish user days (WFUDs) were calculated from historic average proportions of past total use levels which were obtained from the RIM System.
17. Habitat capability for big game was generated by a computer program based on "A Model to Evaluate Elk Habitat in Western Oregon" (Wisdom, et al. 1988)

18. Activity, output, and effect data for the No Change Alternative were in part derived from the current Forest Multiple-Use and Timber Management Plan (1977).

THE FOREST PLANNING MODEL (FORPLAN)

OVERVIEW

Forest planning is a very complex process in which an enormous amount of information must be considered before an alternative management plan can be recommended as the one which best addresses the issues, concerns, and opportunities identified at the outset of the planning process. Because of this complexity, several interrelated computer models and analytical tools have been developed and utilized to help determine the decision space within which alternatives can be developed, and to evaluate their associated outputs and effects.

One of these models is called FORPLAN. The name is an acronym for FOREst PLANning model. FORPLAN is a computerized linear programming (LP) model which has its roots in the Resource Allocation model (RAM) and Multiple-Use Sustained Yield Calculations (MUSYC) models. It is composed of a matrix generator, a linear programming solution system (FMPS), and a report writer. Within the bounds of the matrix generator and the FMPS solution package, the user is allowed a great deal of latitude in formulating the mathematical representation of the Forest planning problem to be analyzed. The Forest's modeling analysis was performed with the Version II, DEO-TEST model. The system is maintained and operated on the Department of Agriculture Univac computer at Fort Collins, Colorado and has been adapted for use on MS-DOS based personal computers by the U.S. Forest Service's Rocky Mountain Forest and Range Experiment Station.

The FORPLAN model was specifically designed to help the IDT analyze the economic and production trade-offs associated with the recreation, timber, scenic, old-growth, water, roadless, and wildlife resources, and to help evaluate the extent to which various alternative management scenarios were able to address and resolve the identified planning issues. One key step in the development of the FORPLAN model was to divide the total Forest into analysis areas. Analysis areas are tracts of land with relatively homogeneous characteristics in terms of the outputs and effects that are being analyzed in the FORPLAN model. Their delineations were intended to capture the significant social, biological, and economic differences in the way the land responds to alternative management strategies. The focus of the delineations was upon the planning issues.

In the FORPLAN model, analysis areas were assigned prescriptions in order to achieve the resource management objectives of a particular benchmark analysis or alternative. Prescriptions are directly related to the management areas described in Chapter II. Two major categories of prescriptions were used in the analysis. Management prescriptions contain the standards and guidelines necessary to meet the multiple-use objectives of each management area. These prescriptions are contained within the Proposed Forest Plan document, Chapter IV. The second category of prescriptions, called FORPLAN prescriptions, contain the details necessary to model the management prescriptions in FORPLAN, and to schedule activities in a cost-efficient manner.

FORPLAN prescriptions are combinations of scheduled activities and practices, and their associated outputs and effects. These prescriptions and their range of timing choices are represented as decision variables in FORPLAN. The outputs and effects associated with the prescription choices are represented as mathematical coefficients in the respective decision variables.

THE FOREST PLANNING MODEL (FORPLAN)

FORPLAN prescriptions are represented at three levels within FORPLAN. At the first level, a set of management emphases parallel the management prescriptions. Second, within many management emphases a set of management intensities are represented as choices in the FORPLAN model. These intensities depict different combinations of activities such as timber harvesting, planting, commercial thinning, etc. At the third level, dozens of different timing patterns and rotation ages were provided for most management emphasis-management intensity combinations on timbered lands.

Operation of the FORPLAN model was designed to ensure that prescriptions were selected in a cost-efficient manner. The prescriptions FORPLAN selected depended upon the objective function and the set of constraints used to represent a particular benchmark or land management plan alternative. The objective function is a mathematical equation which shows how the Forest's objective (maximize present net value or maximize timber production, for example) is affected by the variable values explicitly portrayed in alternative management prescriptions. Constraints are mathematical equations which require that a given amount of an input or output variable be achieved. The given amount is also termed the right-hand side (RHS) due to its location within typical linear programming matrix representation. All constraints must be satisfied before an optimal solution to the objective function is reached.

The objective function was usually to maximize present net value (PNV) or maximize the production of timber. These were subject to first satisfying all the specified constraints. Constraints were designed to guarantee the spatial and temporal feasibility of land allocation and harvest scheduling choices in order to achieve the multiple-use objectives of a benchmark or alternative. Once the model had determined that a feasible solution existed by satisfying all of the constraints, it would then search for the set of prescriptions and timing choices which permitted it to optimize the solution according to the specified objective function.

Analysis Process and Analytical Tools Used

As directed in the Planning Regulations (36 CFR 219.12(f)(8)):

"Each alternative shall represent to the extent practicable the most cost efficient combination of management prescriptions examined that can meet the objectives established in the alternative."

This direction provided overall guidance to the entire analysis process. The IDT analyzed economic efficiency at several stages of the planning process in order to be reasonably assured that the alternatives developed and displayed in the Draft EIS complied with the intent of this direction. The discussion of the analytical process and tools used will follow this general outline:

1. Analysis prior to FORPLAN,
2. How FORPLAN was used in the analysis,
3. Analysis done in addition to FORPLAN model analysis.

Analysis Prior To FORPLAN

The analysis process began with the identification of issues, concerns, and opportunities. The Forest planning team developed an initial set of issues based on an "objectives hierarchy." This structure of objectives tied together both general and specific resource objectives into an understandable and comprehensive format. These issues were then mailed out to the public. General feedback concerning these issues as well as specific responses on the relative importance of the issues was requested. These responses were then analyzed and relative weights assigned to the issues. The objectives hierarchy

and issue descriptions were then modified, based upon public input, and formed the basis for the final Forest issues.

Once the issues, concerns, and opportunities were identified, the Interdisciplinary Team began to formulate management prescriptions and their associated standards and guidelines. This step was probably one of the most difficult and laborious, and possibly the most important task of the interdisciplinary planning process. Management areas coupled with their respective standards and guidelines provide specific direction for implementation, and serve as a framework for how to use, develop and protect the Forest's resources in a manner consistent with the goals and objectives of the various alternatives.

Since the standards and guidelines provide general, rather than site or project specific direction on how to implement the final Forest Plan, little opportunity was available to calculate a present net value (PNV) or benefit/cost ratio for many of them. However, economic efficiency was a strong consideration throughout their development. For example, standards and guidelines for logging system selection list economic considerations as a major criterion. Similarly, timber haul rates and timing must be cost-effective. Intensive timber management prescriptions call for "obtaining the greatest economic return consistent with other resource requirements."

Much of the analysis prior to FORPLAN involved decisions that needed to be made in the design and construction of the FORPLAN model. Concurrently with the formulation of management areas and the standards and guidelines, the IDT also began to identify the analysis areas that would be used in the FORPLAN model. The Forest's grid cell data base was used extensively to analyze different analysis area combinations that could be used to model and evaluate the production and economic trade-offs between the recreation, roadless, timber, water, scenic, old-growth, and wildlife resources on the Forest. The objective of this exercise for the DEIS analysis was to delineate the analysis areas in such a way as to capture the important variations in the biological and economic characteristics of the land in as few analysis areas as possible.

Many of the decisions that were necessary to reduce the number of analysis areas for the DEIS analysis were made unnecessary through the use of relational data base tools in conjunction with the Forest's grid mapping system. Complete detail was maintained in the analysis areas until after the management strategies were combined and the data processed through the side model, "VISPLAN", developed by the Pacific Northwest Regional Office. VISPLAN provided details on the availability and average volume per acre for lands in all strategies with a limited final harvest entry per decade (up to 12% per decade). Based on VISPLAN output, the analysis areas for all strategies except the "general forest" strategy were collapsed, constraints were written for harvesting limited entry areas, and special yield tables were written to accurately reflect the average volume per acre for harvests in the limited entry strategy areas. Final analysis area delineators were focused upon depicting timber production and economic differences.

Once the final analysis area delineation was settled upon, the next step was to develop the prescriptions for the FORPLAN model. This included the development of timber yield tables, other resource yield coefficients, and the economic costs and benefits associated with each FORPLAN prescription. These prescriptions were designed to enable FORPLAN to analyze the economic and resource trade-offs associated with a particular benchmark or alternative, and to select and schedule prescriptions in a cost-efficient manner.

FORPLAN prescriptions are combinations of scheduled activities and practices, and their associated outputs and effects. These prescriptions and their range of timing choices are represented as decision

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variables in FORPLAN. The outputs and effects associated with the prescription choices are represented as mathematical coefficients in the respective decision variables.

FORPLAN prescriptions are represented at three levels within FORPLAN. At the first level, a set of management emphases parallel the management prescriptions. Within many management emphases a set of management intensities are represented as choices in the FORPLAN model. These intensities depict different combinations of activities such as timber harvesting, planting, commercial thinning, etc. At the third level, dozens of different timing patterns and rotation ages were provided for most management emphasis and management intensity combinations on timbered lands.

In designing the FORPLAN model considerable effort was expended in developing the management intensities to be used for each management prescription, and in determining the timing choices to be used for each management intensity. A dynamic programming model, DP-DFSIM, was used to develop timber management regimes that were most efficient in meeting different criteria (e.g., maximum timber volume, and maximum PNV). In addition to these maximums, a wide range of timber yield tables was developed to provide FORPLAN with the harvest scheduling flexibility needed to satisfy the multiple-use objectives of each alternative, and to find the most efficient solution. The complete set of management intensities was also analyzed in terms of present net value on a per acre basis. The final set of intensities selected were based on silvicultural considerations, economic criteria, multiple resource objectives, and the need to provide a wide range of choice for FORPLAN. An entire section, titled *Development of Management Prescriptions and Intensities*, appears later in Appendix B and contains the details of these analyses and the analysis of timing patterns to be allowed.

Another analysis done prior to FORPLAN for some alternatives in the FEIS has been termed the "Spatial Disaggregation Process" (SDP). The same process can be used (depending on the alternatives objectives) to meet hydrologic recovery goals by writing FORPLAN constraints or to measure the effects of timber harvest on hydrologic recovery after FORPLAN has found an optimal solution. The Spatial Disaggregation Process begins with the analysis area information and adds geographically specific data from the mapping system for the factors affecting water quality and the dispersion of created openings. Using this detail, the SDP finds the one most constraining factor for each sub-drainage (there are 454 unique geographically located sub-drainages). When SDP is used to distribute and limit hydrologic recovery, the acres available by sub-drainage are totaled by watershed to generate FORPLAN constraints. When SDP is used to analyze a FORPLAN solution, it estimates the relative risks of violating standards and guidelines for harvest unit location and water quality risks based on hydrologic recovery measures.

FORPLAN Analysis

FORPLAN was used for three principal purposes in the analysis. The first use was to identify the maximum or optimum method of meeting a single objective. This was done primarily in the formulation of benchmarks as part of the Analysis of the Management Situation. The objectives of focus were maximizing present net value (using all values, and using market values only), maximizing timber production, and maximizing recreation opportunities. In all of these benchmarks a review of the implications on the resources not being emphasized was a key concern of the analysis.

The second principal use of FORPLAN was to assess implications of particular policy decisions. This was also primarily done in the context of the maximum PNV benchmark (using all values). In this case, a comparison of FORPLAN results with and without the particular policy feature was used to estimate the impacts associated with the implementation of the policy in question. Among the specific policies examined this way were minimum management requirements (MRs) (including specific comparisons on wildlife MRs, spotted owl MRs, riparian MRs, and spatial dispersion requirements),

departure versus nondeclining flow schedules, limiting first entry rotation ages to 95% of the culmination of mean annual increment, and the impact of different economic assumptions.

The most important use of FORPLAN was in the development of alternatives. Since alternatives are generally multiresource oriented, the FORPLAN model served to identify the most efficient method to achieve, simultaneously, a number of different management objectives. During alternative modeling interaction of constraints was watched closely to ensure achievement and avoid overachievement of the intended objectives of the constraints being modeled. FORPLAN was also used to identify effects of the alternatives on particular areas of resource concern.

The prescriptions FORPLAN selected depended upon the objective function and the set of constraints used to represent a particular benchmark or land management plan alternative. The objective function is a mathematical equation which shows how the Forest's objective (maximize present net value or maximize timber production, for example) is affected by the variable values explicitly portrayed in alternative management prescriptions. Constraints are mathematical equations which require that a given amount of an input or output variable be achieved. The given amount is also termed the right-hand side (RHS) due to its location within typical linear programming matrix representations. All constraints must be satisfied before an optimal solution to the objective function is reached.

The objective function was usually to maximize present net value (PNV) or maximize the production of timber. These were subject to first satisfying all the specified constraints. Constraints were designed to guarantee the spatial and temporal feasibility of land allocation and harvest scheduling choices in order to achieve the multiple-use objectives of a benchmark or alternative. Once the model had determined that a feasible solution existed by satisfying all of the constraints, it would then search for the set of prescriptions and timing choices which permitted it to optimize the solution according to the specified objective function.

Analysis In Addition To FORPLAN

Although many of the outputs and effects displayed in the Draft EIS were calculated directly by FORPLAN, many others were developed through post-FORPLAN modeling processes. Generally, these processes either integrated several factors derived from multiple sources, or required a specific type of disaggregation of model results. The major outputs or effects analyzed by post-FORPLAN processes were fish and wildlife, water, economics, transportation needs, and roadless areas.

The FORPLAN solution was disaggregated to each analysis area and management strategy combination by special report writers maintained by the Pacific Northwest Regional Office and by a data base software package (Paradox) for MS-DOS computers. Coefficients for many of the outputs and effects that were not directly reported by FORPLAN were assigned using relational data base techniques and the SDP was employed to assess the effects of timber harvest levels on hydrologic recovery. Most of the recreation estimates and the economic summaries were calculated using electronic spreadsheets.

Estimation of economic effects also required additional analysis after FORPLAN. The IMPLAN model was used to estimate the effects of the alternatives on county level jobs and personal income. Outputs from FORPLAN, primarily timber and recreation, provided the basic input to IMPLAN. The section titled *Social and Economic Impact Analysis* of this appendix provides more detail on the IMPLAN model. Electronic spreadsheets were used to fully calculate PNV, resource contributions to benefits and costs, and the necessary budgets for benchmarks and alternatives.

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Analysis of transportation system needs and of resource outputs and effects within roadless areas both required specific disaggregations of FORPLAN outputs. FORPLAN timber volumes were distributed to transportation "collectorsheds" for estimation of road mileages needed. An electronic spreadsheet was used to derive estimates of outputs and effects within each roadless area.

FOREST PLANNING MODEL

Identification of Analysis Areas

Overview

Analysis areas serve as the basic land stratification in FORPLAN. They help to describe the Forest land base so that different management options can be analyzed. Analysis areas are a part of the basic decision variable used in the linear program (LP). The other component of the decision variable involves the prescription that is applied to the analysis area. A range of prescriptions are defined for each analysis area. The linear program optimizes over all prescriptions to provide the most efficient combination of prescriptions for each analysis area given the constraints.

As the basic land stratification, analysis areas (AAs) serve several functions in FORPLAN.

1. AAs allow the Forest to be stratified so that management prescriptions may be applied based on different land characteristics. These characteristics help in defining appropriate management activities and their associated costs. The land characteristics can also help to predict the effects of undertaking these activities (the resource yields produced and any financial value they may represent).
2. AAs allow the Forest to be stratified so that management activities and/or resource yields may be constrained to specified levels, fluctuations over time, or relative levels (based on other activities or yields).
3. AAs allow the Forest to be stratified so that management activities or resource yields may be summarized and reported by different geographic areas or vegetative conditions on the Forest.

Level Identifiers

AAs are defined by six levels of information. The six levels are mapped and overlayed to form unique, homogeneous units. Each of the six levels will be discussed summarizing the reasons why the resource information was chosen, and its function in the analysis process. All resource inventory maps used in developing analysis areas have been coded into the Forest grid cell map data base at 1-inch equals 1-mile scale. This equates to a grid cell size of 21.33 acres.

Level 1: Watershed - Watershed delineation was chosen as the identifier or information for the first level of Forest stratification. It is a spatial representation of data. The watershed delineation is comparable to the allocation zones used in the DEIS analysis. Some of the specific boundaries were adjusted to follow district boundaries or to more accurately segregate areas with unique hydrologic or geomorphic conditions. This geographic information is used with other FORPLAN identifiers and other map layers to estimate average production coefficients for FORPLAN or other models that are used to estimate outputs and effects.

Level 2: Not Used

Level 3: Not Used

Level 4: Silvicultural Suitability - Level 4 contains a composite of information that shows where commercial thinning and fertilization are feasible. A full range of timber harvest prescriptions were developed from which the FORPLAN model could select. Areas that are suitable for commercial thinning and fertilization opportunities were identified so that the management costs, growth, and timber yields are accurately reflected in each management prescription.

Areas that are considered accessible for commercial thinning are those that can be reached from either an existing or proposed road within the capability of existing logging equipment. This was assumed to occur a given number of horizontal feet from a road depending upon its topographic location:

Valley roads	- 300 feet each side
Ridge top roads	- 1,200 feet each side
Hillside road	- 300 feet uphill/1,200 feet downhill

Transportation plans and information from the Districts were used to map the existing and proposed road network on 1-inch to the mile topographic maps. The area accessible around each type of road was then mapped based on the horizontal width criteria. See "Accessibility for Commercial Thinning" (Megargel 1982) for more information about development of this layer.

Fertilization opportunities were derived from the soil inventory for the DEIS analysis. The assumptions for fertilization response have changed between the DEIS and FEIS. For the DEIS, only the 19 soil types which had been tested for fertilization response were included in the "responds to fertilizer" classification. For the FEIS analysis, all of the predominantly Douglas fir (60% or greater) timber type lands were assumed to "respond to fertilizer" applications. The actual amount of response predicted is taken from fertilizer response predictions in the yield simulator.

Table B-2. Assignment of Timber Management Intensities

	Analysis Area Identifier			
	Accessible		Not Accessible	
	Response	No Response	Response	No Response
T-1A Minimum Investment	X	X	X	X
T-1B Minimum Investment with Early Entry	-	X	-	-
T-1C Early Entry with Fertilization	X	-	-	-
T-2 Moderate Investment	-	X	-	X
A-2 Moderate Investment and Fertilization	X	-	X	-
T-3 Full Stocking Level Control	X	X	-	-
T-4 High Investment	X	-	-	-

X Indicates the timber intensity allowed for the analysis area identifier combination.

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Timber management intensities available for selection are based, in part, upon accessibility to commercial thinning and fertilization response. Table B-2 shows which intensities are available according to analysis area identifiers. Management intensities that require fertilization will only be an option in areas that show response. Only areas accessible will have the choice of the management intensities that prescribe commercial thinning. Regardless of which logging system happens to overlap with accessible areas, only skyline systems were used in modeling commercial thinning. The majority of thinning done on the Forest utilizes skyline systems. The yield table analysis (Sanders, et al. 1985) showed that thinning with aerial systems was not economically viable. Thinning using ground-based systems is not commonly used.

The timing of thinning and fertilization depends upon timber type association and size class represented in Levels 5 and 6. The "Timber Yield Table Documentation" (Sanders, et al. 1985) process paper gives a detailed description of yield table development.

Level 5: Timber Type - Analysis of the timber production capabilities of the Forest is dependent upon knowing the status of the existing timber inventory, and of the potential growth a site is capable of producing in the future. The timber type association is an important vegetative stratification used to categorize differences and summarize data.

Timber type associations were taken from the four inch to the mile timber type map developed for the 1981 timber inventory. The inventory sampled plots that were stratified based on the Forest's Aggregated Timber Type Model. The model describes the vegetation conditions of timber stands according to the predominant commercial timber species and size class. Five timber type associations were represented in the sampling model:

1. *Douglas fir/western hemlock* - catch-all category for the western hemlock zone;
2. *Douglas fir/true fir* - stands with some true fir, indicating a cooler site than western hemlock;
3. *True fir association* - catch-all category for silver fir zone, with less than 20% Douglas fir;
4. *Mountain hemlock* - stands dominated by mountain hemlock, no noble fir present;
5. *Lodgepole pine* - pure or nearly pure lodgepole pine stands of any size or stocking.

The "Process Documentation for Timber Resource Inventory" (Sloan et al. 1983) describes the timber typing and inventory in detail.

Timber type associations help determine the economics of timber production since the average dollar return per unit volume harvested differs depending upon the species mix. Timber types are also important in estimating wildlife indicator species populations. The Douglas fir/western hemlock association was used in analyzing the hydrologic condition of watersheds. Existing timber inventory and future growth rates also vary by timber type.

Non-forest areas that are less than 10% tree cover, water, rock, or barrens are identified in the timber type class information. Forest cover types are reported for unsuitable lands, withdrawn lands, and for Douglas fir/hemlock lands on non-National Forest. This information is used for estimating both dead tree habitat and hydrologic conditions for each watershed.

Level 6: Timber Size - The last level in the analysis area stratification includes the existing timber size information. This information was taken from the timber typing done for the 1981 timber inventory.

Five size classes were represented for sampling inventory plots based on the Aggregated Timber Type Model (Sloan, et al. 1983):

1. *Seedlings and Saplings/nonstocked* - 0 to 4.9 inches diameter;
2. *Pole Timber* - 5 inches to 8.9 inches;
3. *Small Sawtimber* - 9.0 inch to 20.9 inches diameter, mainly young growth;
4. *Large Sawtimber* - 21 inches diameter and larger;
5. *Old-growth Timber* - 21 inches diameter and larger, usually over 180 years old. Trees are characterized by deeply furrowed bark, ragged tops, and limb clusters in lieu of individual limbs.

The seedling and sapling size strata was not sampled since the inventory plots were not designed to sample vegetation in this size class. After the field work was done in 1981, empirical timber yield tables were developed for each of the type/size combinations. As the timber yield tables were developed, the mountain hemlock and lodgepole pine components were combined into one size class for purposes of timber yield estimation. The plot information showed a mixture of species within the lodgepole pine type, and since the strata is a mountain hemlock climax type, it was combined with the mountain hemlock poles. The two empirical tables were weighted together based upon the suited acres in each strata.

The inventory analysis showed the per acre yields between the large sawtimber and old growth strata were not statistically different. For the DEIS these two size classes were combined. However, public comment received after the DEIS was released cited the importance of correctly identifying old-growth stand characteristics, and there was some concern that the Forest was losing the ability to identify existing old growth. In response, a new inventory was done with the major objective of identifying stand characteristics. The new inventory was named for the type of stands that were to be sampled and is commonly referred to as the Mature/OverMature Survey (MOMS). The survey data allows identification of old growth based on a variety of possible definitions or stand characteristics.

The timber size information that was delineated for the 1981 inventory was current up to January 1980. To represent a more accurate timber inventory, this was updated twice for the DEIS. The timber size class data was again updated for the FEIS (from 1985 to 1989). Also in response to public comments, the seeds/saps size classes were disaggregated into four 10 year age groups by species, using information in the Total Resource Information (TRI) system and the mapping done as part of the Mature and Overmature survey. Average ages now are 10, 20, 30 or 40 years near the midpoint of the first planning decade (1994). This disaggregation is used only for the Douglas fir timber types. The true fir association, mountain hemlock and lodgepole pine timber types are represented by one age class for the seedlings and saplings up to 40 years old. More information on the process of updating the timber size class information can be found in the planning records, available for public review at the Forest Supervisor's Office.

The timber inventory established an average site index and age for each type and size strata. The average site index gives an indication of future growth potential. It was used in developing managed timber yield tables. The average age is used to assign appropriate prescriptions for the first decade of the planning horizon. The assigned ages are shown in Table B-3.

Table B-3. Analysis Area Ages

Timber Type	Timber Size	Age in Years
Douglas fir/hemlock	10-year-old	10
	20-year-old	20
	30-year-old	30
	40-year-old	40
	Poles	60
	Small sawtimber	120
	Large sawtimber	180
	Old growth	240
Douglas fir/true fir	10-year-old	10
	20-year-old	20
	30-year-old	30
	40-year-old	40
	Poles	50
	Small sawtimber	160
	Large sawtimber	190
	Old growth	230
True fir	10 to 40-year-old	20
	Poles	140
	Small sawtimber	160
	Large sawtimber	220
Mountain hemlock/lodgepole	10 to 40-year-old	20
	Poles	160
	Large sawtimber	220

The nonstocked component of the seedling and saplings is not identified separately, but it was recognized through a yield falldown applied to managed timber yield tables applicable to this size class. For documentation on identification of physically unsuited lands, see "Willamette National Forest: Timberland Suitability Documentation" (Mayo and Bernat 1984).

Conclusion

For further discussion of the resource layers used in the level identifiers, see "Data Base Documentation" (Bernat 1984). This process document describes how the source maps were derived and coded into the grid cell map system.

The levels of information that make up the analysis areas are composed of basic geographic, soil, and timber stand characteristics. This information serves in applying appropriate prescriptions and in predicting and constraining resource yields to land areas.

Table B-4 shows the final set of analysis area identifiers that were used to represent the Forest in the FORPLAN model.

Table B-4. FORPLAN Identifiers***LEVEL 1 WATERSHED**

10: BLUE RIVER
 92: BREITENBUSH RIVER
 15: FALL CREEK
 22: HILLS CREEK
 14: LOWER HORSE CREEK
 01: LITTLE NORTH SANTIAM
 07: MCKENZIE RIVER
 11: MCKENZIE LOWER TRIBUTARIES
 13: MCKENZIE (SOUTH FORK)
 05: MIDDLE SANTIAM
 77: NORTH SANTIAM/BLOWOUT/WOODPECKER
 78: LOWER NORTH SANTIAM
 79: UPPER NORTH SANTIAM
 12: QUARTZ CREEK
 04: QUARTZVILLE
 18: SALMON CREEK
 20: SALT CREEK
 06: SOUTH SANTIAM
 16: WINBERRY CREEK
 21: LOWER M.F. OF THE WILLAMETTE
 23: UPPER MIDDLE FORK WILLAMETTE
 19: WILLAMETTE (TRIBS OF THE MIDDLE FORK)
 17: WILLAMETTE (NORTH FORK OF THE MF)
 24: WILLAMETTE (UPPER NORTH FORK OF MF)
 00: LOOKOUT CREEK
 03: TRIBUTARIES OF DETROIT RES.
 09: CALAPOOIA AND WILEY CREEKS
 31: WILDERNESS LAKES
 41: UPPER HORSE CREEK
 61: CANYON CREEK
 71: HACKLEMAN CREEK
 72: SCOTT CREEK
 73: DEER CREEK

***LEVEL 2 NOT USED**

***LEVEL 3 NOT USED**

***LEVEL 4 SILVICULTURAL SUITABILITY**

CR: ACCESSIBLE FOR THINNING -
 FERTILIZATION RESPONSE
 CN: ACCESSIBLE FOR THINNING -
 NO FERTILIZATION RESPONSE
 NR: NOT ACCESSIBLE FOR THINNING -
 FERTILIZATION RESPONSE
 NN: NOT ACCESSIBLE FOR THINNING -
 NO FERTILIZATION RESPONSE
 RD: ACRES OF ROADS
 NO: NON-FORESTED NF LAND
 UW: WITHDRAWN & UNSUITABLE FS LAND
 PP: NON-FS LANDS

***LEVEL 5 TIMBER TYPE**

DH: DOUGLAS-FIR/WESTERN HEMLOCK
 FD: DOUGLAS-FIR/TRUE FIR
 FA: TRUE FIR ASSOCIATION
 MH: MOUNTAIN HEMLOCK/LODGEPOLE PINE
 NF: ALL NON-FORESTED LANDS
 RD: ACRES OF ROADS
 PD: DH ON NON-FS LANDS
 PO: NON-DH ON NON-FS LANDS
 RI: RIPARIAN WITHDRAWN

***LEVEL 6 TIMBER SIZE**

10: STANDS HARVESTED FROM 1977 TO 1989
 20: STANDS HARVESTED FROM 1967 TO 1976
 30: STANDS HARVESTED FROM 1957 TO 1966
 40: STANDS HARVESTED FROM 1947 TO 1956
 SS: SEEDLINGS & SAPLINGS NOT IN 10-40
 PL: POLE STANDS
 MS: MEDIUM SAWTIMBER STANDS
 LS: LARGE SAWTIMBER STANDS
 OG: OLD GROWTH (TIMBER DEFINITION)
 NF: OTHER - ROCK,BARREN,GRASS,WATER
 UW: FORESTED AREAS NOT HARVESTABLE
 PP: NON-FS LANDS
 RD: ACRES OF ROADS

DEVELOPMENT OF MANAGEMENT PRESCRIPTIONS AND INTENSITIES

Overview

In the FORPLAN model analysis areas were assigned prescriptions in order to achieve the resource management objectives of a particular benchmark analysis or alternative. Prescriptions are directly related to the management areas described in Chapter II. Two major categories of prescriptions were used in the analysis. Management prescriptions contain the standards and guidelines necessary to meet the multiple-use objectives of each management area. These prescriptions are contained within the Proposed Forest Plan document, Chapter IV. The second category of prescriptions, called FORPLAN prescriptions, contain the details necessary to model the management prescriptions in FORPLAN, and to schedule activities in a cost-efficient manner.

The National Forest Management Act (NFMA) regulations define management prescriptions as "management practices selected and scheduled for application on a specific area to attain multiple use and other goals and objectives" (36 CFR 219.3). Management prescriptions consist of a goal statement which establishes the purpose of the prescription, and a compatible set of management practices designed to develop and/or protect some combination of resources, and create or perpetuate a desired condition. The standards and guidelines that form the prescriptions were constructed within the requirements specified in 36 CFR 219.27. These requirements guide the development, analysis, approval, implementation, monitoring and evaluation of Forest Plans with regard to:

- Resource protection;
- Vegetative manipulation;
- Silvicultural practices;
- Even-aged management;
- Riparian areas;
- Soil and water; and
- Diversity.

These prescriptions represent a range of management direction, intensity, practices, standards and guidelines. The IDT included the necessary mitigation measures and resource coordination measures that are required to satisfy economic, legal, and social constraints when implementing these prescriptions. The documentation of these measures are found in the Standards and Guidelines of the Forest Plan.

The prescription development and screening process will be presented in detail in the next two sections. The next section will discuss management prescriptions: the process used to construct them; the goals and objectives of the prescriptions; and a standard and guideline comparison table. Following that is a discussion of the FORPLAN prescriptions: the process used to construct and screen timber options; the effects of assumptions made in the screening process; and the prescriptions used.

Management Prescriptions

The Forest uses 38 different management area themes for this FEIS and Plan. A range of prescriptions were developed to analyze alternate ways of managing the unique resources that exist in each management area. Each prescription was evaluated for its interaction and representation in FORPLAN. As the FORPLAN model was developed, many of the management areas were found to contain standards and guidelines that could be accurately represented with only a few FORPLAN "emphases". Table B-5 shows the relationship between management areas, standards and guidelines, and FORPLAN emphasis.

Table B-5. Standard and Guidelines and FORPLAN

Management Area	ROS Class	Recreation Management	Visual Management	Fish and Wildlife Management	Vegetation Management	Timber Management	Road Management	FORPLAN Code
1A	W-TRAN	HI-LIM	PRES	LIM	NAT	NONE	NONE	00
1B	W-SP	MOD-LIM	PRES	LIM	NAT	NONE	NONE	00
1C	W-PT	LO-LIM	PRES	LIM	NAT	NONE	NONE	00
1D	W-PTL	VLO-NONE	PRES	LIM	NAT	NONE	NONE	00
2A	SPM	MOD-LIM	PRES	LIM	NAT	UNREG	LIM-REC	00
2B	SPNM	LO-LIM	PRES	LIM	NAT	UNREG	NONE	00
3	RM	LO-NONE	MOD	RES	RES	RES	RES	00
5A	RN	LO-LIM	PRES	LIM	NAT	UNREG	NONE	00
5B	RN	LO-DEV	RET	LIM	NAT	UNREG	NONE	00
6A	SPNM	LO-LIM	RET	LIM	TIM	HAR-5	LIM-VIS	00
6B	RN	MOD-LIM	RET	LIM	TIM	HAR-5	LIM-VIS	55
6C	RN	MOD-LIM	PAR	LIM	TIM	HAR-7	LIM-VIS	77
7A	RN	LO-NONE	PRES	LIM	NAT	UNREG	NONE	00
8	RN	LO-NONE	RET	EAGLE	NAT	UNREG	LIM-WLD	00
9A	RN	LO-LIM	PRES	PROT	NAT	UNREG	LIM-WLD	00
9B	RN	LO-LIM	RET	ENH	NAT	UNREG	LIM-WLD	00
9C	RN	LO-LIM	PRES	PROT	NAT	UNREG	LIM-WLD	00
9D	RN	LO-DEV	RET	ENH	NAT	UNREG	LIM-WLD	00
10A	RN	MOD-DEV	PAR	LIM	TIM	HAR-10	EFF	10
10B	SPM	MOD-DEV	PAR	LIM	TIM	HAR-7	LIM-REC	77
10C	SPM	MOD-DEV	PRES	LIM	NAT	UNREG	NONE	00
10D	SPNM	MOD-LIM	RET	LIM	TIM	HAR-5	NONE	55
10E	SPNM	MOD-LIM	PRES	LIM	NAT	UNREG	NONE	00
10F	RN	MOD-LIM	RET	PROT	NAT	UNREG	NONE	00
11A	RM	LO-LIM	MOD	LIM	TIM	HAR-12	LIM-VIS	12
11B	RM	LO-LIM	MOD	LIM	TIM	HAR-10	LIM-VIS	10
11C	RN	LO-LIM	PAR	LIM	TIM	HAR-10	LIM-VIS	10
11D	RN	LO-LIM	PAR	LIM	TIM	HAR-7	LIM-VIS	77
11E	RN	LO-LIM	RET	LIM	TIM	HAR-7	LIM-VIS	77
11F	RN	LO-LIM	RET	LIM	TIM	HAR-5	LIM-VIS	55
12A	RN	HI-LIM	PAR	LIM	NAT	UNREG	LIM-REC	00
12B	RN	HI-DEV	PAR	LIM	NAT	UNREG	LIM-REC	00
13A	VAR	VAR	VAR	VAR	VAR	UNREG	VAR	00
13B	VAR	VAR	VAR	VAR	VAR	UNREG	VAR	00
14A	RM	MOD-LIM	MAX-MOD	LIM	TIM	FULL	EFF	TI
15	RN	VAR	PAR	PROT	NAT	UNREG	RES	00

Legend for Table B-5

MANAGEMENT AREAS

1	Wilderness
2	Oregon Cascades Recreation Area
3	H. J. Andrews Experimental Forest
4	Research Natural Areas
5	Special Interest Areas
6	Wild, Scenic and Recreational Rivers
7	Old-Growth Grove
8	Threatened and Endangered Species
9	Special Habitat
10	Dispersed Recreation
11	Scenic
12	Developed Recreation
13	Special & Administrative Use
14	General Forest
15	Riparian

ROS CLASS

W-TRAN	WILDERNESS - TRANSITION ZONE
W-SP	WILDERNESS - SEMIPRIMITIVE ZONE
W-PT	WILDERNESS - PRIMITIVE TRAILED ZONE
W-PTL	WILDERNESS - PRIMITIVE TRAILESS ZONE
SPNM	SEMIPRIMITIVE NONMOTORIZED
SPM	SEMIPRIMITIVE MOTORIZED
RN	ROADED NATURAL
RM	ROADED MODIFIED
VAR	VARIABLE

FOREST PLANNING MODEL

RECREATION MANAGEMENT

VLO-NONE	VERY LOW CONTACT WITH OTHER USERS - NO FURTHER DEVELOPMENT PLANNED
LO-NONE	LOW CONTACT WITH OTHER USERS - NO FURTHER DEVELOPMENT PLANNED
LO-LIM	LOW CONTACT WITH OTHER USERS - LIMITED DEVELOPMENT PLANNED
LO-DEV	LOW CONTACT WITH OTHER USERS - EXTENSIVE DEVELOPMENT PLANNED
MOD-LIM	MODERATE CONTACT WITH OTHER USERS - LIMITED DEVELOPMENT PLANNED
MOD-DEV	MODERATE CONTACT WITH OTHER USERS - EXTENSIVE DEVELOPMENT PLANNED
MOD-STY	MODERATE CONTACT WITH OTHER USERS - STUDY POTENTIAL FOR FURTHER DEVELOPMENT
HI-LIM	HIGH CONTACT WITH OTHER USERS - LIMITED FURTHER DEVELOPMENT PLANNED
HI-DEV	HIGH CONTACT WITH OTHER USERS - EXTENSIVE FURTHER DEVELOPMENT PLANNED
VAR	VARIABLE

VISUAL MANAGEMENT

PRES	PRESERVATION VQO
RET	RETENTION VQO
PAR	PARTIAL RETENTION VQO
MOD	MODIFICATION VQO
MAX-MOD	MAXIMUM MODIFICATION VQO
VAR	VARIABLE VQO

FISH AND WILDLIFE MANAGEMENT

LIM	ENHANCEMENT OPPORTUNITIES LIMITED BY OTHER RESOURCE PRIORITIES
RES	ENHANCEMENT OPPORTUNITIES DETERMINED BY RESEARCH NEEDS
EAGLE	EAGLE HABITAT PROTECTED AND ENHANCED WHERE FEASIBLE
PROT	EXISTING SPECIAL HABITAT FEATURES PROTECTED
ENH	EXISTING SPECIAL HABITAT FEATURES ENHANCED
VAR	VARIABLE

VEGETATION MANAGEMENT

NAT	NATURAL VEGETATIVE PATTERNS MAINTAINED
RES	VEGETATIVE PATTERNS GOVERNED BY RESEARCH NEEDS
TIM	NATURAL VEGETATIVE PATTERNS ALTERED BY TIMBER HARVESTING
VAR	VARIABLE

TIMBER MANAGEMENT

NONE	NO TIMBER HARVESTING ALLOWED
UNREG	NO PROGRAMMED TIMBER HARVEST; UNREGULATED HARVEST MAY BE PERMITTED
RES	TIMBER HARVESTING GOVERNED BY RESEARCH NEEDS
HAR-5	TIMBER REGENERATION HARVESTS SCHEDULED AT A 5% RATE PER DECADE
HAR-7	TIMBER REGENERATION HARVESTS SCHEDULED AT A 7% RATE PER DECADE
HAR-10	TIMBER REGENERATION HARVESTS SCHEDULED AT A 10% RATE PER DECADE
HAR-12	TIMBER REGENERATION HARVESTS SCHEDULED AT A 12% RATE PER DECADE
FULL	TIMBER REGENERATION HARVESTS SCHEDULED AT AN EFFICIENT LEVEL SUBJECT TO MINIMUM MANAGEMENT REQUIREMENTS AND NONDECLINING YIELD (GENERALLY LESS THAN 30% PER DECADE)

ROAD MANAGEMENT

NONE	ROADS GENERALLY NOT PRESENT OR ALLOWED
RES	ROADS CONSTRUCTION/RECONSTRUCTION/MAINTENANCE/MANAGEMENT GOVERNED BY RESEARCH NEEDS
LIM-VIS	ROADS CONSTRUCTION/RECONSTRUCTION/MAINTENANCE/MANAGEMENT LIMITED BY VISUAL OBJECTIVES
LIM-REC	ROADS CONSTRUCTION/RECONSTRUCTION/MAINTENANCE/MANAGEMENT LIMITED BY RECREATIONAL OBJECTIVES
LIM-WLD	ROADS CONSTRUCTION/RECONSTRUCTION/MAINTENANCE/MANAGEMENT LIMITED BY WILDLIFE OBJECTIVES
EFF	ROADS CONSTRUCTION/RECONSTRUCTION/MAINTENANCE/MANAGEMENT BASED LARGELY ON COST EFFICIENCY
VAR	VARIABLE

FORPLAN CODE

00	No programmed timber harvest (nontimbered, Unsuitable, withdrawn, etc.)
55	5% of the area available for final harvest in any 10-year period.
77	7% of the area available for final harvest in any 10-year period.
10	10% of the area available for final harvest in any 10-year period.
12	12% of the area available for final harvest in any 10-year period.
TI	General Forest (Greater than 12% available for final harvest in any period).
PD	Nonnational forest.

The process of developing the management prescriptions began with a review of the issues, concerns, and opportunities, which led to the development of prescription options with related goals and objective statements. The IDT used research literature and professional judgement to identify projects which would be consistent with existing policy, legislative direction and the identified goals.

In addition to addressing ICOs, the process of designing management prescriptions was also guided by the following criteria: (1) prescriptions should be achievable and contain realistic practices, (2) they are to be general enough to accommodate the variable site specific conditions on the ground, (3) they should be specific enough for the IDT to develop accurate resource and economic output and effect coefficients, and (4) to the extent practicable, they should be the most cost effective means of achieving the intent of the prescription.

To a large degree the particular structure used represented a consensus judgement about the type and detail of direction appropriate for management areas. Sufficient detail is necessary to resolve problem areas and provide clear direction. Enough flexibility must be preserved to allow for efficient accomplishment of objectives. Improvement of the accuracy and specificity of data and of analysis techniques may allow more specific direction in the future.

Management practices are implemented within each prescription according to the resource management goals of the prescription and the standards and guidelines. A map of the land allocation for each management area is available for each alternative. This map, in conjunction with the associated prescriptions, and the standards and guidelines identifies where activities will take place during the implementation of any one alternative. Table B-5 compares the major standards and guidelines for each management prescription. The goals of each management prescription are summarized below. Chapter IV of the Forest Plan describes them more completely.

Timber Options

FORPLAN prescriptions are combinations of scheduled activities and practices, and their associated outputs and effects. These prescriptions and their range of timing choices are represented as decision variables in FORPLAN. The outputs and effects associated with the prescription choices are calculated for each decision variable.

FORPLAN prescriptions are represented at three levels within FORPLAN. At the first level, a set of management emphases parallel the management prescriptions discussed in the previous section. Within many management emphases a set of management intensities are represented as choices in the FORPLAN model. These intensities depict different combinations of activities such as timber harvesting, planting, commercial thinning, etc. At the third level, dozens of different timing patterns and rotation ages were provided for most management emphasis and management intensity combinations on timbered lands.

A wide range of yield tables that encompassed all practicable combinations of management practices was developed. The dynamic programming option used with the DP-DFSIM model for Douglas fir types greatly aided this process by automatically selecting the optimum timing and level of activities for a given set of criteria. A set of yield tables was then selected for further analysis in FORPLAN. Decisions made based on this FORPLAN analysis resulted in a final set of management intensities and timing choices used as FORPLAN prescriptions. The actual FORPLAN intensities and timing choices for each analysis area are listed in the FORPLAN data sets (part of the Forest Planning Records).

FOREST PLANNING MODEL

Management intensities developed with DP-DFSIM involved different mixes of reforestation methods, precommercial thinning, fertilization timing, and commercial thin timing. Each combination of activities tested were developed under both a maximum timber volume (MAI) objective function and a maximum PNV objective function. Table B-6 and Table B-7 display the results of these yield tables for Douglas fir/western hemlock and Douglas fir/true fir respectively. More intensive analysis was performed with the Douglas fir/western hemlock timber type than with other types since it occupies over 80% of the suited timber land.

For the true fir and mountain hemlock timber types management intensities were developed with the PROGNOSIS model, involving different mixes of reforestation methods, precommercial thinning, and commercial thinning. Table B-8 and Table B-9 display the results of these yield tables for the true fir and mountain hemlock types respectively.

The number of yield tables used in FORPLAN for the Douglas fir strata was reduced by using DP-DFSIM to analyze all the possible treatment combinations for each objective (maximize volume or present net value). Only the optimum regime for each management intensity was used in FORPLAN. Based on public comment, a prescription that called for one heavy commercial thinning (and consequently led to earlier culmination of mean annual increment and a 60-year rotation) was added to the FEIS analysis. The prescription was chosen by FORPLAN even though it produced a lower mean annual increment and a lower present net value. Both the heavy thinning and the shorter rotation age were valued by FORPLAN for their ability to fill in the harvest schedule during the fifth through seventh decades.

For the true fir and mountain hemlock strata, a range of managed yield tables with various treatment options was developed from the base tables, using PROGNOSIS to determine volumes. Because PROGNOSIS is not an optimization program like DP-DFSIM, many more runs were necessary to determine the optimum regimes. A program called "CHEAPO" was used in conjunction with PROGNOSIS to calculate PNVs and to determine the regimes which would maximize PNV for each management intensity.

Since management options are comparatively few for existing stands, all distinct options were included in the model. Model size considerations prohibited inclusion of all management intensities developed for managed stands. Management intensities were selected based upon economic efficiency, timber volume contributions, silvicultural considerations, and operational practicalities. Tables B-6, B-7, B-8, and B-9 also display which of the following criteria were used to eliminate particular management intensities:

- No precommercial thinning (1);
- Commercial thins were not economically practicable (2);
- Ten-year commercial thinning intervals (3);
- Silvicultural considerations (4);
- Lower PNV (5).

Table B-6. Management Intensities for Douglas Fir/Western Hemlock

95% CMAI Rotation														CMAI Rotation			
Management Intensity Number	Thin Cycle	Thin Economics	Objective Function	Method of Reforestation	PCT Age	FERT Age	CT Age	Age	MAI	PNV	Age	MAI	PNV	Elimination Criteria			
1	N/A	N/A	MAX TIM	Artificial	--	--	--	66	108	\$-386	86	111	\$-312	1			
2	Unconstrained	Thins Must Pay	MAX TIM	Artificial	--	--	66/86	86	115	\$-225	96	122	\$-238	1			
3	N/A	N/A	MAX TIM	Existing Poles	--	--	62	102	96	\$2620	142	99	\$1272				
4	N/A	N/A	MAX TIM	Existing Poles	--	63	62	102	99	\$2627	142	102	\$1243				
5	N/A	N/A	MAX TIM	Artificial	12	--	--	67	133	\$-162	77	136	\$-227				
6	N/A	N/A	MAX TIM	Artificial	12	24	--	57	139	\$-292	67	146	\$-151				
7 ¹	20 year	Thins Must Pay	MAX TIM	Artificial	12	--	57/77	--	--	--	107	148	--	4			
8	20 year	Thins Must Pay	MAX TIM	Artificial	12	--	47/67	77	142	\$-133	107	147	\$-249				
9	Unconstrained	Unconstrained	MAX TIM	Artificial	12	--	27/37/47/77/87	77	149	\$-369	107	154	\$-454	2, 3			
10	20 Year	Thins Must Pay	MAX TIM	Artificial	12	30	47/67	77	154	\$-106	107	157	\$-205				
11	Unconstrained	Unconstrained	MAX TIM	Artificial	12	30	27/57/67	67	157	\$-364	87	165	\$-367	2, 3			
12	Unconstrained	Thins Must Pay	MAX TIM	Artificial	12	30	47/67/77	77	156	\$-120	97	159	\$-222	3			
13	20 Year	Unconstrained	MAX TIM	Artificial	12	30	37/57	67	153	\$-220	87	161	\$-287	2			
14	N/A	N/A	MAX PNV	Natural	--	--	--	64	93	\$-150	94	98	\$-53	1, 5			
15	N/A	N/A	MAX PNV	Artificial	--	--	--	66	108	\$-386	86	111	\$-312	1, 5			

Table B-6. Management Intensities for Douglas Fir/Western Hemlock

Management Intensity Number	Thin Cycle	Thin Economics	Objective Function	Method of Reforestation	PCT Age	FERT Age	CT Age	95% CMAI Rotation			CMAI Rotation			Elimination Criteria
								Age	MAI	PNV	Age	MAI	PNV	
16	N/A	N/A	MAX PNV	Natural	14	--	--	65	116	\$-100	85	119	\$-26	
17	N/A	N/A	MAX PNV	Artificial	12	--	--	67	133	\$-162	77	136	\$-227	5
18	N/A	N/A	MAX PNV	Natural	14	24	--	65	127	\$+41	75	128	\$+40	
19	N/A	N/A	MAX PNV	Artificial	12	24	--	57	139	\$-292	67	146	\$-151	5
20	20 Year	Thins Must Pay	MAX PNV	Natural	14	--	45/65	85	123	\$+65	125	128	\$-52	
21	20 Year	Thins Must Pay	MAX PNV	Artificial	12	--	57/77	77	139	\$-174	107	143	\$-137	4, 5
22	20 Year	Thins Must Pay	MAX PNV	Artificial	12	--	47/67	87	140	\$-74	127	144	\$-234	5
23	Unconstrained	Unconstrained	MAX PNV	Natural	14	--	55/75	75	123	\$+24	115	128	\$+26	2, 3
24	Unconstrained	Unconstrained	MAX PNV	Artificial	12	--	47/67/77	77	136	\$-67	127	141	\$-176	2, 3, 5
25	20 Year	Thins Must Pay	MAX PNV	Natural	14	24	45/65	75	131	\$+134	125	138	\$-18	
26	20 Year	Thins Must Pay	MAX PNV	Artificial	12	30	47/67	67	146	\$-95	117	154	\$-195	5
27	Unconstrained	Unconstrained	MAX PNV	Natural	14	24	55/65	65	130	\$+79	115	137	\$+32	2, 3
28	Unconstrained	Unconstrained	MAX PNV	Artificial	12	30	47/57/67	67	146	\$-134	117	152	\$-141	2, 3, 5
29	Unconstrained	Thins Must Pay	MAX PNV	Natural	14	24	55/65	65	130	\$+79	115	137	\$+32	3
30	20 Year	Unconstrained	MAX PNV	Natural	14	24	55/75	75	137	\$+97	105	140	\$+65	2

¹ Most results were not calculated since the relative density exceeded 60 prior to thinning.

Table B-7. Management Intensities for Douglas Fir/True Fir

Management Intensity Number	Thin Cycle	Thin Economics	Objective Function	Method of Reforestation	PCT Age	CT Age	95% CMAI Rotation			CMAI Rotation		
							Age	MAI	PNV	Age	MAI	PNV
1	N/A	N/A	MAX TIM	Artificial	--	--	86	87	-- ¹	106	90	\$-362
2	Unconstrained	Thins Must Pay	MAX TIM	Artificial	--	76/86	96	94	\$-360	116	99	\$-358
3	N/A	N/A	MAX TIM	Artificial	15	--	77	106	\$-397	87	109	\$-355
4 ²	20 Year	Thins Must Pay	MAX TIM	Artificial	15	67/87	--	--	--	107	125	--
5	20 Year	Thins Must Pay	MAX TIM	Artificial	15	57/77	97	119	\$-298	117	123	\$-348
6	Unconstrained	Unconstrained	MAX TIM	Artificial	15	37/57/77	97	123	\$-489	107	128	\$-497
7	N/A	N/A	MAX PNV	Natural	--	--	84	76	\$-157	114	79	\$-116
8	N/A	N/A	MAX PNV	Artificial	--	--	86	87	-- ¹	106	90	\$-362
9	N/A	N/A	MAX PNV	Natural	17	--	75	93	\$-164	95	96	\$-112
10	N/A	N/A	MAX PNV	Artificial	15	--	77	106	\$-397	87	109	\$-355
11	20 Year	Thins Must Pay	MAX PNV	Natural	17	55/75	105	105	\$-59	115	107	\$-83
12	20 Year	Thins Must Pay	MAX PNV	Artificial	15	57/77	97	115	\$-228	117	120	\$-281
13	Unconstrained	Unconstrained	MAX PNV	Natural	17	65/75/85	95	100	\$-41	115	105	\$-70
14	Unconstrained	Unconstrained	MAX PNV	Artificial	15	57/87	97	116	\$-227	117	121	\$-273

¹ PNV not calculated since the final harvest did not pay.

² Most results not calculated since the relative density exceeded 60 prior to thinning.

Table B-8. Management Intensities for True Fir

Management Intensity Number	Method of Reforestation	PCT Age	FERT Age	CT Age	95% CMAI Rotation			CMAI Rotation		
					Age	MAI	PNV	Age	MAI	PNV
1	Natural	--	--	--	135	62.9	\$-176	175	66.0	\$-181
2	Artificial	--	--	--	77	87.2	\$-413	97	90.6	\$-396
3	Natural	--	--	95	125	66.5	\$-173	155	69.4	\$-177
4	Artificial	--	--	67	87	92.1	\$-390	107	94.0	\$-377
5	Natural	15	--	--	75	81.3	\$-196	95	84.5	\$-178
6	Artificial	15	--	--	77	91.5	\$-418	87	93.9	\$-401
7	Natural	15	--	65	85	85.4	\$-175	95	86.9	\$-188
8	Artificial	15	--	67	87	95.8	\$-389	97	97.9	\$-386

Table B-9. Management Intensities for Mountain Hemlock

Management Intensity Number	Method of Reforestation	PCT Age	FERT Age	CT Age	95% CMAI Rotation			CMAI Rotation		
					Age	MAI	PNV	Age	MAI	PNV
1	Natural	--	--	--	105	46.4	\$-183	125	48.3	\$-171
2	Artificial	--	--	--	67	69.4	-- ¹	97	70.4	\$-370
3	Natural	--	--	105	125	51.9	\$-173	165	54.1	\$-181
4	Artificial	--	--	77	87	74.3	\$-367	97	75.7	\$-375
5	Natural	15	--	--	75	66.7	\$-152	85	68.5	\$-165
6	Artificial	15	--	--	77	75.9	\$-381	87	77.4	\$-397
7	Natural	15	--	75	85	69.6	\$-176	95	70.9	\$-185
8	Artificial	15	--	77	87	78.8	\$-403	97	80.0	\$-417

¹ PNV not calculated since the final harvest did not pay.

Those intensities without precommercial thinning were eliminated since they were inferior both in terms of PNV and in timber volume when compared to intensities with precommercial thinning. Intensities where revenues returned from the timber volume sold were insufficient to cover expenditures were also eliminated. This occurred primarily with commercial thinnings and had the effect of forcing commercial thinnings to occur later in the rotation for the intensities retained. The third criterion was based on District experience with laying out and administering timber sale contracts for commercial thinning. The extremely large number of acres to be thinned when thinnings are scheduled every 10 years was considered to be operationally unworkable. The Forest cannot legally operate two sales in the same area at the same time. The effect of dropping intensities with 10-year thinning intervals was to have fewer thinnings with the remaining intensities. A fourth criterion, silvicultural considerations, resulted in the elimination of a few yield tables due to the scheduling of commercial thinnings after stand relative density exceeded a value of 60. Forest silviculturists felt that the DP-DFSIM model projected an unrealistic growth pattern after commercial thinning stands with relative densities greater than 60. A final criterion resulted in the elimination of management intensities with a low PNV if similar intensities were available with a higher PNV. Those management intensities without any elimination criteria listed were carried forward into the next analysis step.

Potential effects due to use of these screening criteria can be estimated by comparing two tables that are identical except for the parameter of interest. For example, to estimate the volume loss of criterion 3, ten-year thinning intervals, under a maximum timber objective, for Douglas fir/western hemlock, compare intensities 10 and 12 from Table B-6. In the MAI column under CMAI rotation the difference between 157 and 159 indicates a 2 cubic feet/acre/year potential effect.

A final set of analyses were performed examining the use of natural regeneration versus planting, the competitiveness of non-timber prescriptions with timber prescriptions in terms of PNV, and the types of timing choices to provide FORPLAN. These analyses were combinations of both FORPLAN and non-FORPLAN analysis.

Since the per acre stand level analysis in DP-DFSIM consistently showed natural regeneration to be more economically efficient than planting, intensive analysis of this question was done. To achieve the biological conditions for successful natural regeneration, a seed source is needed. This is accomplished by using a two-stage removal process on the stand to be harvested. The trees left after the first entry provide the seed source for stand establishment. The second entry removes the seed source after stand establishment occurs and completes the harvest operation.

Since there is a period of about five years between the two entries, a reduction in PNV for the existing stand occurs. The net revenues associated with the second entry are delayed and the effects of discounting make them worth less in today's dollars. In the analysis displayed in Table B-10, the reduction in PNV on the existing stand more than offset the PNV gain on the managed stand for the natural regeneration prescription. These results indicate that if natural regeneration is selected when either method would accomplish the reforestation objective, a loss in total PNV would result.

Table B-10. Analysis Results

Rx/Stand	Existing Stand	Future Managed Stand	Total
Plant	11,210	-284	10,926
Natural Regeneration	10,251	-132	10,119
Difference	959	-152	807

Additional analysis of this issue was also conducted with FORPLAN. Two runs that used the maximize PNV objective function were compared. The only difference between the two runs was that one allowed natural regeneration prescriptions to be considered in addition to planting, and one did not. Only 393 acres of natural regeneration came into solution on the run where this option was available. This result could be due to the factors described in the previous paragraphs, or to the ability of FORPLAN to harvest more high valued existing timber by bringing into solution planting intensities with higher future volumes.

A preliminary analysis of other resource prescriptions was conducted outside of FORPLAN to determine if they could compete with timber on a per acre basis. Dispersed recreation and scenic resource prescriptions were analyzed and compared to timber prescriptions. This analysis showed that when an existing stand of mature timber is present, other resource prescriptions with their higher costs, could not compete despite higher recreation values. If an existing stand could not be harvested immediately, the higher recreation values enabled a number of these other resource prescriptions to be economically competitive. To determine if this would still hold true on a Forest-wide basis when future stand growth considerations enter into the analysis, a FORPLAN run was made which included the most competitive of the other resource prescriptions. Approximately 920 acres went to a scenic prescription in this run. Since this represented less than 0.1 percent of the suitable timber acres, non-timber prescriptions were dropped from further consideration when PNV was the sole objective.

Finally a *Stage II* (discounted present net value per acre) financial analysis was completed. The results showed that values per acre were dependent upon timber type, volumes per acre, logging cost class (average logging cost in a watershed), and projected growth rates. Present net values range from over \$11,000 per acre for Douglas-fir stands on flat ground, to almost zero for many mountain hemlock/Lodgepole stands on steep ground. Timber harvests in areas where positive financial returns are questionable will be carefully reviewed.

Development of Yield Coefficients

Timber Yield Coefficients

Timber yield tables for the Willamette were developed for three separate components; i.e., empirical yield tables for existing mature stands, managed yield tables for plantations and future stands, and merchantable material available but not regulated, such as salvage. Each of these three components will be discussed in this section. Processes for constructing empirical yield tables and for building tables for the unregulated volume were relatively simple. More intensive effort was expended on development of the managed tables. The "Timber Yield Tables" process record contains further details (1920 12/31/84).

The empirical yield tables were generated from information obtained from the Willamette National Forest Timber Inventory by the Regional Office. The timber inventory information was compiled by

timber type and size class stratum. The existing stand volume per acre was determined. The rate of growth on the growing stock was also determined. Curves were constructed for both the projected stand volume and the projected growth. These curves were then combined to create a controlled volume curve that predicts future volume for each stratum. Empirical yield tables were then tabulated from this curve (USDA Forest Service, R-6).

Between the DEIS and FEIS, new defect and breakage (D&B) values were calculated for the empirical yield tables, to more accurately reflect the variation by species and size class. Cruise data from a sample of timber sales across all Ranger Districts was used to determine the percent D&B for poles, small sawtimber, large sawtimber and old growth for each of the model components. A reduction in breakage was applied to large sawtimber and old growth stands, based on uphill falling studies on slopes of 30% or greater. The yield tables have also been updated for growth to 1994.

The Douglas fir Simulator (DFSIM), a growth and yield model, was used to simulate a wide variety of growth and harvest patterns over time for the Douglas fir and Douglas fir/true fir managed yield tables (Curtis, 1981). With DFSIM the user can simulate yield regimes for Douglas fir under different regeneration options (planted or natural) with or without precommercial thinning (PCT) and with or without fertilization. For a given set of investments, the goal was to find the combination of intermediate harvest and final harvest that best met the objective of maximizing volume or present net value (PNV). To search for the combination of thinnings and final harvest over different rotation ages that best met the objective and constraint set would require a great number of DFSIM runs.

Dynamic programming in conjunction with DFSIM (DP-DFSIM) is a computer program that automates the search for yield regimes in DFSIM that optimizes either volume or PNVs, and does so in a computationally efficient manner (Johnson 1984).

Yield tables were developed to represent each objective for a range of management intensities from "natural regeneration with no intermediate treatments" to "planting genetically improved stock with full stocking level control plus fertilization."

Three major operational constraints affecting commercial thinning entries were placed in the DP-DFSIM program for the yield tables eventually selected for use in FORPLAN. Commercial thinning entries had to be spaced at least 20 years apart, had to break even economically, and had to be scheduled before the relative density reached 61 when called for after PCT. Relative density (RD) expresses the average level of competition in a given stand, relative to a stand of maximum density. Numerical values range from 0 to 100. Relative density was constrained because DP-DFSIM ignores the effect of high initial RDs on the growth of trees after thinning. Some of the optimal regimes allowed the RD to exceed 60 and still showed normal response to thinning. To avoid this, any regime which showed a RD of 61 or greater prior to a commercial thin (if PCT'd) was dropped from consideration (2410 Plans, May 22, 1984). Without PCT, the stand exceeds 60 RD before reaching commercial thinning size.

The above constraints generally resulted in commercial thinning regimes that were similar to what empirical appraisals had indicated were necessary. The average stand diameter at the first commercial thin is about 12 inches, and the per acre volume removed is 4,000+ board feet depending on the logging system. A ground-based system with lower logging costs requires less volume to break even than a skyline system. It must be emphasized that these figures are averages for the entire Forest, and individual stand prescriptions by certified silviculturists will vary depending on site-specific conditions.

The different logging system costs produced some minor differences in yield tables due to the amount of commercial thin volume needed to break even. If the objective is to maximize volume, an unconstrained DP-DFSIM run shows numerous light thins starting at age 27 with as little as 200 board feet per acre removed to be best. With operational constraints, the lower costs for ground logging means lighter

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thins are possible and produced slightly higher volumes over the rotation than skyline systems. Aerial logging costs were too high to allow commercial thinning to break even.

Separate yield tables were developed for ground and skyline logging systems. However, the differences were minor, the greatest being 3 cubic feet mean annual increment (MAI). The Forest area designated suitable for ground logging includes high-lead cable systems which cannot be used for commercial thinning. These areas (90% of the ground logging area) will have to be skyline thinned, and, therefore, would fit the skyline yield tables. Because of these considerations, only the skyline yield tables were used.

For the objective of maximizing PNV, the best regime is to thin heavy as soon as possible to generate revenue and offset the earlier investments. In this case, skyline and ground logging systems thinned the same amounts. Only the PNV was different due to the different logging costs. Again, only one yield table was necessary. FORPLAN applied the appropriate costs for each logging system at the time of final harvest.

A major consideration was the precommercial thinning level and the effect it would have if commercial thinning was delayed until the stand averaged about 12 inches d.b.h. (Reukema 1979). The precommercial thinning level was set at 300 trees per acre in the Douglas fir/hemlock, Douglas fir/true fir, and true fir types and 400 trees per acre in the mountain hemlock stratum. Three hundred trees were picked in the DFSIM model because this was the bottom limit of data, and the model operation is such that it never reaches a point where growth does not respond to lower stocking and taper off. Bob Curtis, the Douglas fir simulator model developer (DFSIM), does not recommend modeling precommercial thinnings below 300 trees per acre. Thinning below 400 trees per acre in the PROGNOSIS model caused volume losses. However, when 400 trees per acre was used in the true fir stratum, a large jump in mortality was observed before commercial thinning, and the RD approached 65. This indicated undesirable overstocking. Reducing stocking to 300 trees solved the problem with little loss in MAI. The mountain hemlock stratum did not show the large jump in mortality when age 30 stocking was set at 400 trees per acre.

The optimum precommercial thinning age is 12 years for the Douglas fir/hemlock stratum and 15 years for the other strata. Actual precommercial thinning within that range is not very sensitive. For natural regeneration, PCT was not scheduled until stand age is 14. This additional time to PCT is due to the difference in height growth between planting a 2-0 seedling and a natural germinant. Calculation of the net MAI is based on the age of the stand plus the time between harvest and planting (regeneration lag). Using Forest-wide information stored in the TRI systems, the average time between sale closure and planting was found to be 1.9 years for the period 1978 to 1980. This was considered the most recent data available for normal operations. The actual period of bare land condition would be somewhat longer depending on the amount of time between harvest and sale closure. Based on this, a 3-year regeneration lag between the time trees are severed from the stump and the unit is adequately restocked was considered most accurate. For natural regeneration, 2 years was added for a total regeneration lag of 5 years. This is due to the inconsistency of seed production from year to year.

The DFSIM model is based on data from actual stands. However, very little information was included on stands over 80 years old. Growth and yield outputs for ages 80 to 100 are considered plausible extrapolations. The program contains a warning that stand statistics beyond 100 years are gross extrapolations of the model.

Yield information was also needed for longer rotations beyond age 100, for wildlife, visuals, riparian management, and dispersed recreation.

It was decided to use the empirical yield tables growth for longer rotations and to gradually change from managed to empirical tables over a five-decade period. This provides a smooth transition between tables and a gradual slowdown of growth.

The time at which the shift begins is age 100 or the age at CMAI on the DP-DFSIM run, whichever is greater. A few regimes culminated a little beyond age 100. DP-DFSIM often shows a different regime is better for longer rotations, so no information would be available beyond CMAI. For these situations, DFSIM runs were matched to the DP-DFSIM regime and the rotation extended five decades beyond age 100 or CMAI, in order to provide the necessary information for the shift to the empirical tables. The point at which the empirical table is entered is where the basal area most closely matches the managed basal area at age 100 or CMAI.

The DFSIM model was generally believed to be inappropriate for the true fir and mountain hemlock strata. The data base does not include stands growing under these ecological conditions. By their classification, Douglas fir can only be a minor component. Observations and plot data show that although height growth may not be as good as that of trees growing in lower elevations, the sites can support good diameter growth, and that growth can be maintained for long periods of time (Hegyi 1981). In the DFSIM model, stands with low site index appear to be concentrated on warmer sites with low productivity.

The PROGNOSIS model, developed in Northern Idaho by Stage (Wykoff 1982), was examined and then chosen as the model to develop yield tables in these upper elevation strata. The model was chosen because:

- The ecological types of the silver fir zone closely resemble conditions in Northern Idaho where the model was developed,
- The model was developed for mixed true fir stands,
- There is a strong white pine data base and white pine is becoming a more important tree in these elevations,
- The model can handle a mixture of age classes,
- The model provided great flexibility for local calibration. Therefore, of all outside models, it looked like the most adaptable,
- It had excellent support in Region 1, and they were willing to help adapt it to Willamette National Forest conditions.

The PROGNOSIS model was adapted and calibrated as follows:

- Species were grouped to conform to species in the model. Noble fir, white fir and grand fir were grouped under grand fir. All cedars were grouped under western redcedar. Silver fir and subalpine fir were grouped under subalpine fir.
- Instead of using site index to calibrate growth, the model uses habitat type. After consultation with Miles Hemstrom, the Area Ecologist, the subalpine fir/beargrass habitat type was chosen as a broad representative habitat type for model building.
- The model requires that a Forest aspect and slope be input (Wykoff, 1982). Parameters chosen were the Clearwater Forest, an aspect of northwest and a slope of 5%. Most of the true fir zone lies in the New Cascades where the slopes are fairly level and the aspects west facing.

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- The model has a diameter growth calibration feature in which actual plot growth is used to modify the internal growth equations. All inventory plots in the true fir and mountain hemlock strata were run for one 10-year cycle in the model to find the calibration factors for each species. Multiple linear regression analyses were then run to determine if there were trends that could be found to recalibrate the diameter growth functions.
- Most relationships were weakly correlated, although the regression line was significant. Data for Douglas-fir in both the true fir and mountain hemlock strata were combined to increase accuracy. Noble fir had to be similarly combined.
- Height growth had to be modified to fit Willamette National Forest conditions. The shape of the curves generated by the model was compared with growth curves developed for ecology plots and published curves for west coast conditions and species (Herman 1978). Height growth modifiers were then applied to force the model to follow the shape of the local curves.

Model projections started at stand age 30, the estimated time it would take the stand to reach approximately 5 inches d.b.h. Five inches was chosen because this is the point the PROGNOSIS model switches from the small tree to the large tree growth model. Individual species diameters at age 30 for the mountain hemlock and true fir strata were calculated from increment cores taken on ecology plots in the silver fir zone. Only cores were used that showed little or no signs of early suppression. Not enough white pine was sampled in mountain hemlock types for a good diameter estimate for that stratum. The diameter was estimated by using the difference in diameter for noble fir between the mountain hemlock and the true fir stratum, and Englemann spruce had too small a base in the mountain hemlock stratum. Therefore, the same approximate starting diameters were used for these species in both strata.

- Mortality estimates are the weakest part of most models. The embedded mortality estimates in the model are from northern Idaho. The estimates appear too high when compared to local conditions. Two checks were made of the mortality rates. First, rates in the model were compared with rates experienced for Douglas-fir at Wind River in the 50-year old stocking study (Reukema 1979). Mortality rates for similar stocking densities were only 54% as large as the model rates. At first, an adjustment was made to the model to reduce the mortality to Wind River rates until age 50. Then an adjustment was made to use the model rates after that. Two problems developed: (1) for runs made with no commercial thinning, a too rapid buildup of the basal area (BA) was experienced; (2) when commercial thinning was done, recovery of the BA appeared too slow.

The top end of the BA is limited by the BA function of the model. The model limits the BA by increasing mortality rates to reduce stocking. For the true fir stratum, maximum basal area was set at 367 square feet. This is one standard deviation above the average BA for the stratum. For the mountain hemlock stratum, the average inventory BA of 243 square feet was set as the maximum. The average was used for the mountain hemlock stratum because it was felt that the environmental conditions are such that sustaining basal areas much over our in-place average will not be possible.

The maximum BA function did not entirely solve the problem of a too rapid rise of BA in the 50 to 120-year age range. BA projections from sample model runs were compared with published normal yield tables. The model was reprogrammed so that the maximum BA for each age class was then limited to those published values. Grand fir tables developed by Cochran (1979) were used for the first 100 years, and tables developed for white pine by Haig (1932) were used for older stands. Site index 60, age 50 base, was used for the true fir stratum; and site index 50 was used for the mountain hemlock stratum. This was based on curves developed from site index data on inventory plots.

The problem still remained of the model mortality rates reducing stocking faster than growth could recover. In order for the model to be able to grow trees approximately along the normal curve, mortality rates were reduced to 0.75 of model estimates for the true fir stratum and 0.8 for the mountain hemlock stratum.

- An economic analysis was used to determine the diameter of the first commercial thinning. This occurred at the start of decade seven after harvest for both true fir and mountain hemlock strata. The residual commercial thinning level was first estimated using the default values in the model. The model residual thinning basal area was 45% of normal tree numbers as determined from Haig's normal yield tables for second growth white pine.

This was rounded down to the nearest 10 square feet. This produced residual basal areas of between 190 and 200 square feet. That appeared too high. Mortality rates continued at high levels. Other smaller residual basal areas were tried and 170 square feet was settled upon. This produced a residual relative density of about 42 after thinning.

- Precommercial thinning levels were chosen so that relative density would not be over 63 at the time of the first commercial thinning. The rationale for this upper limit was the same as in the Douglas fir/hemlock and Douglas fir/true fir strata, except a higher limit was set because of the greater tolerance of the trees. For the true fir strata, trees were precommercially thinned to 300 trees per acre; while the mountain hemlock strata was thinned to 400 trees per acre.

For all the yield tables developed from both DFSIM and PROGNOSIS it was necessary to develop adjustments to convert from gross volume per acre to net volume and to allow for volume falldown resulting from natural and manmade conditions. There are two types of adjustments: 1) an acreage adjustment which reflects land areas too small to be deleted from the suitable timbered land base, but which are unsuited for timber management (understocked plantations, nonstockable areas in plantations due to poor site, soil compaction, root rot, etc.); or 2) a yield adjustment which reflects changes due to defect and breakage, fertilization, and genetics.

The adjustments:

- A percentage reduction for plantations with stocking that meets legal minimum, but is low enough to reduce full yield.
- A reduction for unstocked areas within plantations resulting from poor site conditions, disease, soil compaction or loss, competing vegetation, and future catastrophic losses due to fire, wind, insects, etc.
- A reduction for defect and breakage which shows up at time of harvest. This would vary with age and size.
- An increase for genetics.
- An increase for fertilization.
- Wildlife trees.
- Future road construction.

The rationale behind the adjustment percentages is described in the following paragraphs:

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- *Understocked Plantations* - A total of 5,244 plantations on the Willamette National Forest were analyzed for stocking. It was found that a significant number of these plantations were poorly stocked. Poor stocking will have an effect on the final harvest production.

The percentage of understocked acres was determined for each species stratification. These percentage relationships are 2% for Douglas fir/ hemlock, 6% for Douglas fir/true fir, 6% for true fir, and 3% for mountain hemlock. It was assumed that the main falldown in volume will be uncaptured commercial thinning volume. The amount of commercial thinning volume was adjusted by the poor stocking percentages to obtain a factor to be applied to the yield tables. These factors are 0.5% for Douglas fir/hemlock, 1.0% for Douglas fir/true fir, 1.0% for true fir, and 0.5% for mountain hemlock.

- *Unstocked Holes in Plantations and Future Catastrophic Losses* - The above factors account for entire plantations that are understocked. Many other plantations contain localized unstocked areas due to unsuited soils, soil compaction or loss (landings, skid roads, etc.), competing vegetation, disease (primarily root rot pockets), etc. Information on holes in the plantations was obtained from the Districts. Each District submitted a list of plantations (representing a 10% sample of previous 3 years data) showing an estimate of unstocked and nonstockable areas within each plantation. These estimates were weighted by acreage sampled per District for each strata to obtain Forest averages. This resulted in an adjustment of 7% to the Douglas-fir/ hemlock and Douglas-fir/true fir strata and 8% to the true fir stratum. There were no samples of the mountain hemlock stratum. It was decided to use 8% in the mountain hemlock stratum also.

There is little information on the effect on this Forest of insects and wind in managed stands. Future losses are assumed to be negligible. Past fire history was used to determine what losses could be expected in the future. The amount of land burned has decreased from 1,000 acres/year over the last 30 years to 300 acres/year over the last 10 years. Volume loss due to fire will probably continue to decline as detection and preventive methods improve and access increases. This loss should be well below 0.5%. Overall, the Forest should not experience major losses, and any volume reduction will be assumed to be included in the above deductions. Actual catastrophic losses would be dealt with by a plan revision.

- *Defect and Breakage* - The defect and breakage figures for managed stands are the same ones used in the current Land Use Plan. These figures were obtained from a 2470 memo to the files dated December 22, 1975. The deductions in the memo were broken down into more age groups than the present strata. Deductions were picked as close to the median as possible for each timber size grouping.
- *Genetics* - Theisen (1980) summarized expected gains from genetic tree improvement programs. The Forest's adjustments were based upon those recommendations.

The Forest is just getting into seed orchard management. At the present time, it is difficult to predict when seed orchards will become available in significant amounts. Therefore, only the gain attributed to seed collected from select trees was included in the yield tables.

A blanket gain of 10% for planting stock grown from select tree seed was added to all the yield tables that apply to plantations planted from the beginning of the new Forest Plan and beyond. No genetic gains will be assumed for plantations established before the beginning of the new plan. Select trees have been identified in all strata.

- *Fertilization* - In order to gain some consistency in the absence of statistically significant data for individual Forests, the Regional Office directed the westside Forests to use the DP-DFSIM model to determine response to fertilizer (2410, April 12, 1984). The Region also directed that fertilizer could be applied once to all stands containing at least 60% Douglas fir. These stands make up the Douglas fir/hemlock model component. An application rate of 200 pounds/acre is generally the most cost effective and was used in DP-DFSIM. The DP-DFSIM model was used to determine the optimal stand age for application without resulting in a relative density of 60 or more before the first commercial thinning. The application of fertilizer resulted in a 15% increase in mean annual increment after 7 years and an overall increase in CMAI of 8% for full stocking level control (FSLC) with genetics.
- *Wildlife Trees* - To meet wildlife tree requirements over time, it is necessary to leave green replacement trees that can be used when the existing trees no longer provide habitat. Wildlife trees were cruised on a number of timber sales across the Forest to determine volume reductions for the yield tables. Each of the green trees represents about 2% of the net volume per acre. Depending on the existing condition of a watershed, the FORPLAN model will leave enough trees to maintain at least 0.8 wildlife trees per acre and make the appropriate reduction in the yield tables. There is also a factor to account for the effect of the trees on the growth of the understory.

In addition to the empirical and managed timber yield components a third timber yield component includes volume not reflected in the empirical and managed yield tables. This volume includes "salvable dead" (salvage from harvest units), "chargeable dead salvage" (salvage found throughout the Forest), "nonchargeable cull" (unsound material used as chips, etc.), "unregulated" (nonscheduled volume such as from the Experimental Forest), and "nonchargeable miscellaneous convertible products" (shakes, posts, firewood, etc.). These components were all separately calculated and included in the total "Timber Sale Program Quantity."

An analysis of sell and harvest records was done to obtain an assumed average percentage increase to the decade timber harvest for chargeable dead salvage, nonchargeable cull volume, unregulated volume, and miscellaneous convertible products.

The Cut and Sold Reports were used to obtain the average annual sold volume (both sound and cull) from 1977 to 1982. The average sound volume was then used as the base green volume to be used in calculation of percentage increases for cull, salvage, and other miscellaneous volumes.

The Cut and Sold Reports provided the nonchargeable cull volume and the other convertible products, such as posts, shake bolts, etc.

The Timber Inventory Adjustment Record for fiscal years 1980 through 1982 provided the sound, salvable dead, and the unregulated volume from land not allocated for timber production.

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The volume adjustments thus calculated are shown below:

Type of Volume	Percent Increase
Chargeable Dead Salvage	3.6
Nonchargeable Cull	20.6
Unregulated	0.1
Nonchargeable Miscellaneous Convertible	0.2

Total Percent Volume Increase	24.5

This volume is available only in the existing, unmanaged stands, and will decrease as these stands disappear. For future managed stands, volume adjustments will remain the same for unregulated and nonchargeable miscellaneous convertible products but will drop to zero for chargeable dead salvage and nonchargeable cull material. The total future adjustment will be 0.3%.

The salvable dead volumes per acre are obtained from the 1981 inventory statistics. This volume is not included in the empirical yield tables, but represents additional sound volume available at final harvest, and has been added to the ASQ figures from FORPLAN. These values ranged from about 2.4 to 2.6% depending on species and size class. The amount reflects a deduction to show the preservation of large snags for wildlife. To model this, two trees per acre of about 20 inches d.b.h., were deducted from the small saw diameter classes; and two trees of about 21 inches d.b.h. per acre were deducted from the large saw/old-growth diameter classes. The "no thinning" tree volumes were calculated from the managed yield tables by dividing the volume per acre by the number of trees for the desired diameter class. The managed yield tables give the volume down to a 7-inch d.b.h. with a 4-inch top. The inventory calculates merchantable volume using a 9-inch d.b.h. and a 6-inch top. At these large diameters, however, it is felt that the difference in merchantable tree size would have very little effect. There were no adjustments made for the difference in merchantable tree standards.

These yield tables apply only to the natural stands. The mortality in the managed stands will not be captured in the model, but instead it will be available for wildlife needs.

Wildlife Coefficients

Wildlife effects and outputs were estimated for Threatened and Endangered species, Management Indicator species, big game, and wildlife and fish user days. Effects on Bald Eagles, spotted owls, pileated woodpeckers, and martens is based upon allocations. Information on the amount of land needed to provide for these species can be found in FEIS, Chapter III, *Wildlife* and no additional information will be displayed here. The effects on primary cavity excavators are based on habitat estimates generated from FORPLAN. FORPLAN outputs for big game cover and forage were used to calibrate another big game model (based on the A Model to Evaluate Elk Habitat in Western Oregon) which was eventually used to generate cover constraints for some FORPLAN alternatives and to estimate effects for all alternatives. User days were estimated based on data from the Oregon Department of Fish and Wildlife in conjunction with the big game model.

Spotted Owls - Habitat capability for the Forest was calculated using the same formulas used in the Final Supplement to the Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide. Acres of habitat and timber harvest levels were calculated using FORPLAN. It was assumed that harvest was evenly distributed across the available habitat. Habitat fragmentation was calculated using Forest Mature and Overmature Inventory data in the GIS system (Douglas fir and Douglas fir/true fir stands greater than 21 inches in diameter) to generate maps and randomly selected 2.1 mile circles to determine the proportion of the forest that maintained 1500 acres of habitat with a

minimum 300 contiguous acres of core to meet the habitat requirements of spotted owls. Details of the process are on file.

Pileated Woodpeckers - Forplan was used to generate the acres of suitable habitat and rate of timber harvest over time for pileated woodpeckers. Habitat was defined as Douglas fir, Douglas fir/true fir and true fir stands greater than 19 inches in diameter. The percentage of the Forest capable of supporting pileated woodpecker individuals was calculated as the number of 1 mile circles with 1000 acres of suitable habitat, including a 300 acre core.

Martens - FORPLAN was used to generate the acres of suitable habitat and rate of timber harvest over time for martens. Habitat was defined as all timber type stands greater than 19 inches in diameter. An additional forage component was added for stands between 12 and 18 inches in diameter. The percentage of the Forest capable of supporting marten individuals was calculated as the number of 1 mile circles with 600 acres of suitable habitat, including a 160 acre core.

Primary Cavity Excavators (PCEs) - Dead trees (snags) per acre greater than 18" in diameter provide estimates of the Forest's ability to provide habitat for cavity-dependent wildlife through the planning horizon. The 18" requirement is based on the needs of species known to exist on the Forest (Schreiber, 1987, Nelson, 1988). Snag coefficients for both existing and replacement timber stands are based on snags being produced by suppressed trees which are generally one inch smaller in diameter than the average tree.

If the trees are less than 18" in diameter they will not provide habitat for all primary cavity excavator's. Conversely, if more than 3.8 dead trees per acre (or 4.2 for high elevation areas) are available they may not be fully utilized because of minimum home range sizes. Therefore, the yield of snags per acre does not follow the actual number of dead trees but measures the usable dead trees only. Snags less than 18" in diameter are not reported and snags that exceed 4.2 trees per acre are not reported.

Specifically, yield simulators project that 2 snags of up to 18" in diameter will die each year for every 100 acres of 19" trees. This relationship holds for all timber types on the Forest. Based on this data, each timber yield table that is less than 19" in diameter does not produce 18" snags, yield tables between 19" and 20" contain 2 snags per acre greater than 18", and yield tables greater than 20" in diameter contain 3.8 (or 4.2) snags per acre.

Existing dead trees and live replacement trees will ensure that objectives for snags will be met in all replacement stands throughout the rotation. The number of snags in timber stands regenerated during the planning period will match the desired level (usually between 0.8 and 1.6 snags per acre).

Existing data on the longevity of any individual snag indicates that a dead tree that is about 18" in diameter will provide suitable nesting habitat for PCEs for about 50 years (Cline, S.P., 1980). In order to provide snags throughout the rotation of the replacement stand, some green trees which will eventually be killed need to be left on each harvest unit. The combination of existing snags and green replacement trees needs to be enough to maintain snag levels until the regenerated timber stand reaches at least 18" in diameter. From 1 to 3 replacement trees (depending on diameter) are required for every snag that is needed.

Big Game - Estimates of big game populations or population trends depend upon our ability to provide food (forage), various types of shelter (cover), and freedom from harassment (low road densities). In addition, size and spacing of the forage and cover need to be distributed for maximum utilization, as elk demonstrate a preference for areas that are close to both forage and cover.

Forage estimates are generated based on existing meadows, timber stand openings, and management techniques like burning and fertilization. Forage production in timber stands ends as crown closure

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occurs. Optimal cover in mature and old-growth stands provide forage as the canopy opens up and allows growth of forage species. Lichens, typical to this habitat, are another important forage component.

Hiding cover is provided by any timber stand that creates short viewing distances (generally stands with trees greater than 2" in diameter). Usable thermal cover requires timber stand canopy closure and some amount of pruning of the lower branches (tree diameters greater than 8" and canopy closure greater than 50%). Optimal thermal cover provides both forage and cover in the same timber stand. This combination requires some openings in the timber canopy and multi-layered stand structures that begin to occur in stands over 170 years old.

The size and spacing variable in the Westside Model measures the distribution of forage and cover areas over the landscape. Optimally, units would be 60 acres or less and evenly distributed to allow maximum utilization of all forage areas. Cover areas should be larger, but be close to forage units.

Road density is the final variable that affects elk habitat. Low densities (less than 1.5 miles of road/square mile of habitat) limit poaching and harassment of elk, lowering their energy needs.

The Westside Model combines all four of these variables to measure the habitat effectiveness. In addition, each variable has minimum thresholds for quality. Thus (for example) an area that has a high overall Habitat Effectiveness value due to few roads, excellent cover and high forage values would be less effective if all the forage was concentrated in one site, causing a low value for size and spacing.

Fish Coefficients - Estimates of Smolt Habitat Capability (SHC) outputs follow direction in the 1920 Memo of May, 1, 1987 on Anadromous Fish Planning Coefficients. These coefficients were developed by a Regional Anadromous Fishery Task Force.

The memo recommended that for Steelhead smolt densities be from 4 to 20 smolt/100 square meters (M^2), and spring chinook densities should be between 5 and 40 smolt/100 M^2 .

The FEIS information is presented in terms of Smolt Habitat Capability (SHC) of existing habitat with adequate escapement and rehabilitation, and SHC of potential habitat with adequate escapement and rehabilitation.

The initial estimates of total SHC under existing conditions and escapement were developed in cooperation with ODFW during development of the DEIS. These estimates projected smolt densities of 2 to 4.2/100 M^2 for steelhead, and 34.5/100 M^2 for spring chinook in the McKenzie River. However the densities for steelhead were lower than suggested in the memo, and reflected current habitat conditions in the Fall Creek and Santiam River systems. The densities for chinook were at the high end of the range, but again, reflected the high quality habitat of the McKenzie River.

Smolt densities for 70 miles of additional chinook habitat was estimated as lower than the densities found in the McKenzie River. This estimate was based on field knowledge of the stream conditions available in the potential habitat.

The increase in smolts attributed to stream rehabilitation and enhancement projects was estimated to be 30 steelhead/structure, and 75 steelhead/structure, with 50 structures placed per mile. It was estimated that 60 miles of existing habitat would be rehabilitated and 30 miles of the potential habitat would be rehabilitated. When these increases were calculated they were within the range recommended in the memo.

The SHC estimated with this method was considered to be maximum under Alternatives L and W.

Estimates of the differences between alternatives were made based on a side model which accounted for erosion, riparian condition, and hydrological recovery. This side model was used in the DEIS. From the DEIS information, a regression was identified between acres harvested and decreases in smolts, and this regression was applied to the FEIS calculations.

Hydrological Recovery

Hydrological Recovery is calculated to estimate the capability of timber stands to intercept snow, rain and wind during rain on-snow events. Hydrological Recovery is used to assess the potential risk of adverse effects to stream channels and water quality from increases in peak flows during rain on snow events.

Hydrological recovery is calculated with the Aggregate Recovery Percent method. This method was first described by Forest Hydrologist J. Christner in a May 11, 1982 memo to District Rangers, with a curve describing the relationship of tree diameter and tree age to percent recovery, based on an average Forest Site Index of 91. A memo dated August 2, 1984 updated the recovery curve when it was determined that the average Site Index was 96. These recovery curves were based on studies of windspeeds in clearcuts and forested areas on the Oakridge Ranger District. (Christner 1982)

During development of the DEIS, the coefficients shown in the recovery curve of 1984 were used to develop intermediate values for each increase in tree diameter of 0.1 inches as shown in Table B-11. The recovery coefficients shown in the table were used as needed to assess the hydrological recovery in subdrainages and watersheds for the FEIS, Chapter IV. They were also combined into 6 categories for use in FORPLAN, to distribute the harvest according to the sensitivity of the watershed.

Table B-11. Hydrology Condition Recovery Coefficients

0-2 inches		2-4 inches		4-6 inches		6-8 inches	
DBH	% Recovery	DBH	% Recovery	DBH	% Recovery	DBH	% Recovery
0	0	2.0	14.0	4.0	45.0	6.0	90.0
0.1	0.4	2.1	15.2	4.1	45.0	6.1	93.3
0.2	0.8	2.2	16.4	4.2	49.4	6.2	96.3
0.3	1.2	2.3	17.6	4.3	51.6	6.3	97.0
0.4	1.6	2.4	18.8	4.4	53.8	6.4	97.1
0.5	2.0	2.5	20.0	4.5	56.0	6.5	97.3
0.6	2.4	2.6	21.6	4.6	58.4	6.6	97.3
0.7	2.8	2.7	23.2	4.7	60.8	6.7	97.6
0.8	3.2	2.8	24.8	4.8	63.2	6.8	97.9
0.9	3.6	2.9	26.4	4.9	65.6	6.9	98.0
1.0	4.0	3.0	28.0	5.0	68.0	7.0	98.4
1.1	5.0	3.1	29.7	5.1	70.2	7.1	98.4
1.2	6.0	3.2	31.4	5.2	72.4	7.2	98.6
1.3	7.0	3.3	33.1	5.3	74.6	7.3	98.8
1.4	8.0	3.4	34.8	5.4	76.8	7.4	99.0
1.5	8.0	3.5	36.5	5.5	79.0	7.5	99.2
1.6	10.0	3.6	38.2	5.6	81.2	7.6	99.4
1.7	11.0	3.7	39.9	5.7	83.4	7.7	99.6
1.8	12.0	3.8	41.6	5.8	83.6	7.8	99.6
1.9	13.0	3.9	43.3	5.9	87.8	7.9	100.0

¹ J. Christner Letter FSM 2520 (2410, 1920), August 2, 1984. Intermediate Values Derived by Linear Interpolation.

Watershed Cumulative Effects Risk Rating

The watershed cumulative effects analysis in Chapter IV included a rating of relative risk between alternatives. Information on future riparian conditions, levels of sediment, and hydrological recovery was combined to assign a rating of High, Moderate, or Low. Information from the direct and indirect effects section for each watershed was assessed by assigning points to each of the three parameters as follows:

			POINTS
1.	RIPARIAN	Less than 4% reduction in LWD/decade	0
		4% or more reduction in LWD/ decade	1
2	INCREASE IN DEBRIS SLIDES	0% to 25% above natural	0
		26% to 40% above natural	1
		Over 40% above natural	2
3	HYDROLOGICAL RECOVERY	Meets Midpoint ARP in all subdrainages	0
		Within 1% to 5% of Midpoint ARP	1
		Exceed Midpoint ARP by over 5%	2

Watershed Risks were then assigned based on the total points.

LOW	0-1 TOTAL POINTS
MODERATE	2 TOTAL POINTS
HIGH	3+ TOTAL POINTS

Erosion Coefficients

Two different methods for developing erosion rates were evaluated: (1) Use of theoretical techniques or yield simulators, and (2) Use of empirical data. Due to the lack of an appropriate simulator for Forest erosion production and lack of time and data necessary to calibrate such a model, the decision was made to use available empirical data from the Forest and from other applicable studies. Use of actual local data was considered superior to estimates derived from models developed under different conditions.

A contract with the Pacific Northwest Forest and Range Experiment Station (PNW) in Corvallis was issued to develop the rates for the Forest. (Swanson and Grant 1982). There were several reasons why this decision was made:

- The original data were readily accessible to PNW researchers.
- Many of the people involved in the studies on the Forest were located at PNW and OSU.
- If the work was done on Forest, a review by Research would have been desirable anyway.
- PNW researchers were more familiar with current methods of analyzing erosion and erosion data than Forest personnel.

The final report is available in the Forest Planning Records and will be summarized in this section. Erosion was modeled from two sources - surface erosion and debris slides.

Surface erosion - Data were collected from nine studies - eight located in the H.J. Andrews Experimental Forest and one located near Ryder Creek, South Fork McKenzie River. Inorganic material from collection boxes were totaled for each year sampled. Sampling frequency and length varied. The studies occurred between the years 1967 through 1982. Length of sampling ranged between approximately one year to five years. Sampling frequency ranged between four collections per year to twelve collections per year. When data was missing for a period, the two adjacent periods were averaged. In some cases where it was felt that rates from individual boxes were high and not characteristic of the site, the boxes were not averaged in with the others. In addition, the report points out that the variety of measurement techniques used on different sites makes comparison between values somewhat questionable (PNW Final Report, p. 3). However the values were assumed to be comparable when data from different sites were combined to calculate the rates.

Annual yield rates per acre were calculated by dividing the weight by the estimated contributing area in both bounded and unbounded study areas. Two studies used unbounded plots which increases the uncertainty when expressing rates on an area basis since the contributing area could only be assumed. Weights were transformed into volumes by assuming the specific weight of inorganic erosion was 1.5 grams/cubic centimeter (1 gram equals 8.47×10^{-7} yd³).

Table B-12 summarizes the surface erosion rates. Data were available for only eight Soil Resource Inventory (SRI) units so it was not possible to derive rates for the different classes of SRI surface erosion potential. Surface erosion rates are given by slope class for the background Forest condition and after clearcutting, with and without burning.

Erosion production is a dynamic process; however, it is difficult to represent temporal variations because the data are limited. In one study that sampled twelve years after treatment, observed rates were similar to the background Forest condition. The report concludes that in many sites surface erosion rates following management activity may decline to rates typical of Forested areas within ten years (PNW Final Report, P.8). None of the studies sampled for a full ten years, so some assumptions were made to derive decade averages. In the case where the site was re-sampled after twelve years, the decade value represents the average between the first and twelfth years. In all other cases, a gradual decline to the background Forest rate was assumed after the observed first and second years. Therefore,

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the background rates and the rates two years after treatment were averaged to derive the first decade values.

A limited number of studies have looked at the rates of surface erosion from Forest roads. Two studies on the Forest evaluated different seeding treatments for reducing erosion of bare cut and fill slopes. Based on these studies, the report concludes that road erosion rates are an order of magnitude greater than rates for clearcut and burned sites (PNW Final Report, p.11). It also states that soil erosion rates on roads approach the clearcut, burned rate after five to seven years. Based on this information the following steps were taken by the Forest to calculate surface erosion rates for roads:

- The clearcut, burned rate was multiplied by ten to represent the rate after road construction. This rate was assumed to last for the first six years.
- The clearcut, burned rate was assumed to represent the remaining four years of the first decade.
- The higher six year rate was averaged with the four year rate to derive the first decade rate.

Table B-12. Summary of Surface Erosion Rates

Slope Class Percent	Surface Erosion Rate yd ³ /acre/year		
	Background Forest Rate	Clearcut, Unburned 1st Decade	Clearcut, Burned 1st Decade
0-30	4.7x10	0.0006	0.034
31-60	0.023	0.072	0.22
61+	0.13	0.615 ¹	1.1

Taken from PNW Final Report, Table 3 (p.33).

¹ The report did not provide a value, so it was estimated by the Forest to be the average between the Background Forest rate and the Clearcut, burned rate.

$$\frac{0.13 + 1.1}{2} = 0.615$$

Debris Slides - Debris slides have been inventoried in six studies on the Forest using a combination of aerial photos and field investigation. However, only three were done with comparable methods and standards. These three--H.J. Andrews Experimental Forest, Alder Creek, and Blue River--were used as a basis to calculate erosion production from debris slides. Landslide events were inventoried from the years 1950 through 1981. Only those greater than 100 cubic yards were recorded. Slide areas and volumes were determined from estimates of scar width, length, and depth measured in the field. Slides were assigned to an SRI unit based on their position and classed by whether they occurred in natural, managed (clearcut), or roaded areas.

In order to determine rates per acre, the Forest provided PNW with total acres in the three conditions (natural, managed, and roaded) by SRI unit. Natural areas were defined as:

- Pole stands equal to or greater than 64 acres
- Small sawtimber
- Large sawtimber and old-growth
- Noncommercial and rock
- Permanent grass

Managed areas were defined as:

- Pole stands less than 64 acres
- Nonstocked and seedling/saplings
- Treated areas as of October 1981

Road miles as of 1981 were also provided by the Forest. For each study area, miles by SRI unit were determined with a map wheel. Road acreage was calculated by assuming eight acres per mile. This area was then subtracted from the acres in the natural condition by each SRI unit.

The slide rate for a SRI unit was calculated by dividing the number of events in each management class by thirty years (the period of inventory) and then by the acres in each class. Rates were also given in terms of area and volume disturbed by multiplying an average area disturbed and volume per event as reported in the original studies.

Annual slide rates were calculated, based on 3 major SRI groups. SRI units were ranked in terms of slope and bedrock conditions with some minor modifications. SRI complexes were assigned the class of the major unit, except when the classes were unstable and stable, in which case the moderately stable class was assigned. Table B-13 summarizes the debris slide rates. The three groups were defined as:

- *Stable* with gentle slope (less than 40 percent) of any rock type, moderate slopes (40-60 percent) with hard rocks (basalt and andesite flows), and rock outcrops with little or no soil.
- *Moderately stable* with steep slopes (60 percent), hard rocks; and moderate slopes, soft rocks (tuff, breccias).
- Potentially *Unstable* with steep slopes, soft rocks.

Temporal variations are also important in predicting slides, but again the data available is less than optimal. Of 26 debris slides that were inventoried in clearcuts, 88 percent took place within ten years after harvest. The report concludes that 90 percent of the slides in clearcut areas occur in the first decade after cutting (PNW Final Report, p.16). In addition, based on the sample of road-related slides, they believe that 80 percent of the slides from roads built to current Forest Service standards occur in the first decade and 20 percent in the second decade after construction. These temporal variations were represented in the calculations.

Effectiveness of Mitigations - All work from this point forward was done by planning personnel on the Forest. The next step in the process was to estimate the effectiveness of mitigation measures used in harvest units and road construction.

The index rates from the erosion study were adjusted to reflect mitigations described by the alternative being assessed. These practices include site specific prescriptions for potentially highly unstable areas, particularly adjacent to Class IV streams, elimination of sidecast practices in road construction, and improved road drainage practices. Estimated acres of "unstable," and "moderately stable" occurring on steep upslope areas and adjacent to Class IV streams are accounted for in FORPLAN modeling in Alternative W. In this alternative, the index rates for debris slides are reduced to reflect the mitigation.

Adjustments to the index rates to reflect mitigations were based on the available research, and on discussion with watershed specialists on the Forest. The consensus was that these practices substantially reduce the potential for debris slides, but cannot entirely erase the risk, because of the unpredictability of natural conditions, and the current understanding of the mechanisms of debris slides.

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Research on the reduction of debris slides has been conducted primarily in the Oregon Coast Range. The effectiveness of measures to reduce mass debris slides in harvest units was based on monitoring of headwall leave areas in Mapleton District of the Siuslaw NF, and on estimates of professional watershed specialists on the Willamette NF. The Mapleton study showed that leaving 2 to 5 acre "headwall leave areas" reduced mass debris slides approximately 63% compared to clearcuts. (Swanson & Roach p.90) The proposed mitigation measure to retain trees on Class IV streams to provide streambank stability is estimated to reduce debris slides into streams by 17%, for a total of an 80% reduction in volume failed when compared with practices as assessed in the PNW Final Report.

The magnitude of reduction of debris slides from roads was based on "Road Location and Construction Practices: Effects on Landslide Frequency and Size in the Oregon Coast Range." This paper showed that in 3 landtypes in the Coast Range the volumes of landslides were reduced from 117 cubic yards per slide on roads constructed with sidecast in the 1960s to 6 cubic yards on steeper roads, where waste material was end-hauled. On another landtype the reduction was from 265 to 111 cubic yards with the same type of improvement in practices. For the FEIS it was estimated that improved road practices would reduce debris slides to one-quarter of the 1945-1975 rates, with no average watershed rate higher than 5 cubic yards/road acre occurring.

Further adjustments were made in the erosion rates to more accurately model watershed conditions. For each erosion process influenced by management activities (road construction and timber harvest) included in the analysis, weighted average rates were calculated for each watershed. Acres were summed by different characteristics depending upon the erosion process being modeled. Factors used as a basis for weighting the rates within watersheds for individual processes included:

- Stability Class
- Slope Class
- Soil Suitability
- Availability for timber harvest
- Merchantable Timber (Pole size and larger)
- Timber Type

Table B-13 displays the rates used as a basis for calculating the weighted average rates for each process. For more information on erosion rate and volume calculations, see the Soil Erosion Process Paper.

Table B-13. Erosion Rate Summary

Erosion Type	Stability Group	Background Forest Rate	TP1 Managed Without Enhanced Protection ¹	TP2 Managed Without Enhanced Protection ¹	TP1 Managed With Enhanced Protection ¹	TP2 Managed With Enhanced Protection ¹
Surface ² (Harvest)	0-30% slope	4.7×10^{-7}	0.206	0	N/A	N/A
	31-60% slope	0.023	0.161	0	N/A	N/A
	61% + slope	0.13	0.906	0	N/A	N/A
Surface ² (Roads)	0-30% slope	4.7×10^{-7}	0.218	0	N/A	N/A
	31-60% slope	0.023	1.408	0	N/A	N/A
	61% + slope	0.13	7.040	0	N/A	N/A
Slide (Harvest)	Stable	0	0	0	0	0
	Moderately Stable	0.220	0.550	0.061	0.330	0.030
	Potentially Unstable	0.270	1.500	0.167	0.600	0.060
Slide (Roads)	Stable	0	4.600	1.150	1.150	0.287
	Moderately Stable	0.220	8.000	2.000	2.000	0.500
	Potentially Unstable	0.270	68.00	17.0	17.0	4.250

¹ Assumes harvest units include protection of potentially unstable stream Class IV and headwall areas, and assumes roads are constructed with compacted fills.

² Rates shown assume 60% of areas are burned, 40% unburned. Enhanced protections are not projected to have any effect on surface erosion rates.

Recreation Coefficients

Recreation capacity and use coefficients were developed for each of the various Recreation Opportunity Spectrum (ROS) classes. Development of these coefficients involved developing projected demand and capacity estimates for each of the categories tracked. In cases where capacity was always greater than projected demand for any Alternative, demand estimates were utilized for projected use coefficients. In cases where capacity was less than projected demand, capacity estimates were utilized for projected use coefficients. The following paragraphs describe the process used for generating these demand and capacity estimates. Detailed documentation can be found in the planning records.

In order to determine the most likely rate of change in future recreation use it was necessary to examine trends in historical data. The primary source of visitor use data for the Forest is the Recreation Information Management (RIM) System. RIM files contain use data for specific activities and sites on the Forest which can be combined into appropriate categories for analysis and display. All use and capacity data in this Appendix are expressed in terms of recreation visitor days (RVDs). One recreation visitor day equates to twelve hours of use.

A survey of the literature revealed a number of studies which developed indices or growth rates for future recreation use for various activities or groups of activities on a National, Regional, State, and local area basis. Since RIM activities are fairly specific and projections are generally only available for broader categories, some aggregation was necessary. Thus, similar RIM activities were grouped into classes for which projections were available from a number of sources. RIM data for 1980-89 were analyzed in these activity groupings. Table B-14 contains the 1980 through 1989 use by activity grouping and the percent change over this time period.

This Table shows some fluctuation in the data extracted from the RIM system. These may be the result of inconsistencies in estimating or reporting use from public and private sector sites and areas.

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Despite these vagaries, relatively clear trends are evident in the data from the past decade and RIM contains the best recreation use estimates available for Forest planning analyses.

During the 1980-89 period, participation in most recreation activities increased at varying rates with some noticeable peaks, valleys, and plateaus in the trend lines. It seems evident from the figures that recreation use is affected by such variables as weather and travel costs. Although use in most activities showed some decline during the 1980-89 period total use has increased steadily. Total recreation use did not change from 1981 to 1982. This may be due in part to the economic recession that the region was going through.

Two activity groupings show a decrease in participation over the 10-year period: Organized camping and Resort use. Hiking and picnicking use dropped dramatically in 1975 in 1982 and have only recently regained their 1982 participation levels. Swimming use follows a similar pattern. Between 1982 and 1985, Swimming use decreased significantly. Since then, it has risen to approximately the 1982 level and shown increases over the last four years.

The most popular recreational activities on the Willamette National Forest are camping, driving for pleasure, fishing, and boating-related activities. In 1982, participation in these activities represented approximately two-thirds of the total recreational use on the Forest. Next in popularity were swimming, picnicking, hiking, and resort use. These activities occur at a variety of sites located throughout the Forest.

Table B-14. Recreation Use for Selected Activities¹ ²(Thousands RVDs)

Activity	1980	1981	1982	1983	1984	1985	1986	1987	1988 ³	1989 ³	Average Annual % Change 1980-89
Camping	982.0	1,027.7	1,027.7	1,053.3	1,059.1	1,101.1	1,123.9	1,207.2	1,259.6	1314.3	+ 3.4
Driving/ Sightseeing	399.1	416.2	413.1	403.1	418.4	434.4	469.8	481.0	491.7	502.7	+ 2.6
Hiking	128.7	170.2	140.9	145.8	144.2	154.2	140.9	164.8	176.8	189.7	+ 4.7
Picnicing	166.8	168.0	145.0	152.6	162.6	163.2	173.2	174.4	179.8	185.4	+ 1.1
Boating/ Waterskiing	222.9	225.4	226.3	232.2	218.8	217.5	226.3	244.1	250.1	256.2	+ 1.5
Swimming	135.2	164.9	147.7	109.2	125.6	147.9	166.2	171.0	180.9	191.3	+ 4.2
Horseback Riding	23.3	24.3	24.1	26.1	24.3	28.8	28.6	28.4	29.8	31.2	+ 3.4
Downhill Ski- ing	21.0	4.2	22.5	26.8	36.6	49.0	40.8	50.9	51.9	52.5	+15.0
Cross Country Skiing	12.7	9.6	16.6	25.5	26.2	29.9	23.2	31.0	32.2	34.4	+16.3
Other Winter Sports	36.9	30.5	37.2	37.5	45.7	46.3	44.3	48.2	51.4	54.8	+ 4.9
Organization Camping	79.1	69.0	69.2	70.4	71.8	62.2	64.6	60.2	61.1	62.2	- 2.1
Resort Use	116.6	117.8	119.0	90.5	93.7	96.8	94.5	98.2	99.2	100.2	- 1.4
VIS	56.1	54.5	57.7	66.1	61.1	62.4	64.3	61.2	62.8	64.5	+ 1.5
Hunting	84.6	86.7	85.8	84.0	84.4	89.1	85.8	99.5	102.8	106.2	+ 2.6
Fishing	261.5	233.4	260.7	256.4	253.4	266.9	274.4	297.2	307.6	318.3	+ 2.2
Other	65.8	85.3	93.8	94.1	99.9	101.8	93.8	80.7	83.5	86.4	+ 3.2
TOTAL	2,792.3	2,887.7	2,887.7	2,873.6	2,926.2	3,053.9	3,114.1	3,268.0	3,421.2	3,551.1	+ 2.7

¹Source: USDA Forest Service, Recreation Information Management System (RIM).²Includes use attributed to Wilderness.³Source: Estimates of Forest use based on historical use patterns.

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Future recreation use will likely be affected by changes in various socioeconomic indicators (e.g., population growth, disposable income, leisure time, etc.), the availability of opportunities, technology, weather conditions, and other variables. For Forest planning purposes, it is necessary to develop estimates for dispersed, developed, and Wilderness use for the 50 year planning horizon. Due to large uncertainties about the variables affecting future use, projections become more tenuous as they are extended further into the future.

Studies which have developed future growth projections for recreation cannot anticipate fluctuations in weather patterns nor predict events such as world energy crises or economic recession. Their projections generally assume that an underlying demand is present and will increase with a growing population that has an ever-increasing awareness and appreciation of recreation values. Based on these factors and the general trends in past use on the Willamette, it seems appropriate to assume that future participation in all activities on the Forest will increase as long as opportunities are provided.

To determine future participation rates for all activities in the Forest, recreation activity projection rates of three separate studies were reviewed. During the DEIS projection rates of the State Comprehensive Outdoor Recreation Plan-Oregon (SCORP-Oregon); Projections of Future Forest Use, USDA Forest Service, 1979; and Pacific Northwest River Basin Commission, 1979 were compared. The annual growth rates for recreation use developed in the River Basins Commission study were selected for making use projections in the development of the DEIS and Draft Forest Plan.

However since release of the DEIS and Draft Forest Plan, more recent studies of user preferences, and use projections for a wide range of recreational activities have been completed. In addition historical use data for the Forest has been updated for more accurate comparisons with use projections of recent studies. In 1987 the Pacific Northwest Outdoor Recreation Study (NORS) was completed and in 1988 a draft of the State Comprehensive Outdoor Recreation Plan (SCORP) for Oregon Was issued. The NORS study is a regional approach to integrated recreational planning and management among public agencies and is directly related to SCORP processes of participating states. The NORS study included the states of Washington, Oregon and Idaho.

The SCORP utilizes NORS results from the Oregon Survey portion of the study. Further, Oregon's SCORP subdivides the state into geographic regions for the purposes of recreation planning. The Willamette National Forest is included in the State's Mid-Willamette Valley Region (Region 8). Oregon's SCORP provides recreation use projection rates for activity groups for each of its regions. Average annual growth rates for activities within SCORP Region 8 for 1991-2010 are displayed in Table B-15.

The annual growth rates for recreation activities presented in the draft SCORP and developed through the NORS study were selected for making use projections for the Forest's FEIS and Forest Plan. Use projections for the Mid-Willamette Valley, SCORP Region 8, closely approximate the Forest's historical use trends for the period 1980-1989. They were selected for use because they exceed SCORP projection rates on a state-wide basis, are specific to the Forest's primary area of influence, are the most current projection rates available, and are also the highest projection rates for all studies reviewed and thus may show the upper level of use expected in the year 2010.

Table B-15. Recreation Projection Rates

Activity Group	1991-2010 Rate ¹	2011-2040 Rate ²
Camping	3.7	1.40
Driving/Sightseeing	4.9	1.40
Hiking/Walking	4.1	1.40
Picnicking	3.8	1.40
Boating/Waterskiing	5.5	1.40
Swimming	4.2	1.40
Horseback Riding	1.7	1.40
Downhill Skiing	2.6	1.40
Cross Country Skiing	2.8	1.40
Other Snow Activities	3.1	1.40
Organized Camping	1.0	1.40
Resort Use	1.0	1.40
Visitor Information	2.5	1.40
Hunting	2.5	1.40
Fishing	2.5	1.40
All Other Activities	2.5	1.40

¹Source: Oregon State Comprehensive Outdoor Recreation Plan (SCORP)-Draft 1988. Activity groupings listed in SCORP were grouped according to the categories shown above. Projection rates for this time period represent a moderate scenario of future use for SCORP's Mid-Willamette Valley Region 8.

²Source: Bonneville Power Administration 1982. Forecasts of electricity consumption for the Pacific Northwest.

Selecting an appropriate growth rate for recreation participation beyond the year 2010 is more difficult since there are few projections of the underlying factors affecting these activities. An annual average rate of 1.4% for the period 2011-2040 is assumed for the Forest. This rate represents an extension of the Bonneville Power Administration (BPA) forecasts of electricity consumption in the Pacific Northwest (Appendix I, Economic/Demographic Projections, May 1982), and projected population growth rates for the Pacific Northwest and the State of Oregon.

As mentioned earlier, RIM site data are useful for distinguishing between dispersed and developed use. The Wilderness portion of dispersed use is contained in separate tabulations by Wilderness Area. The 1980 to 1989 historical RIM data were examined to determine if the proportions of dispersed, developed, and Wilderness use were changing significantly over time (i.e., is one type growing at a faster rate than another?). Although some annual fluctuations exist, the 10 year average was very close to the 1982 proportions. Thus, the most recent data available were used as the base for projections. It was assumed that activities will continue to occur in the same proportions within the broad categories of dispersed, developed, and Wilderness use throughout the projection period.

To facilitate comparisons with capacity estimates, projections for developed use were estimated by applying the growth rates to activity use within specific types of sites (e.g., observation sites, picnic areas, campgrounds, etc.).

For dispersed and Wilderness use, the growth rates were applied to the activity totals to obtain total use for each time period. Total use was disaggregated to Recreation Opportunity Spectrum (ROS and WROS) classes to facilitate comparisons with existing and potential supply categories. ROS classes are combinations of physical, social, and activity settings which provide a certain type of recreational experience. The disaggregation of activity use to ROS classes was based on observed patterns of activity

participation in Forest recreational settings. A summary of dispersed, developed, Wilderness, and total use projections unconstrained by supply is presented in Table B-16.

Table B-16. Total Projected Recreation Use

Use Type	Thousands of RVDs per Year					
	Current Use	1991 - 2000	2001 - 2010	2011 - 2020	2021 - 2030	2031 - 2040
Developed	1,723	2,056	2,953	3,393	3,899	4,481
Dispersed	1,481	1,790	2,623	3,014	3,464	3,980
Wilderness	345	413	596	685	787	905
Total	3,549	4,259	6,172	7,092	8,150	9,366

The second major component of recreation use coefficients are the capacity estimates. These were constructed for dispersed, developed, and Wilderness recreation. The estimated capacity values are an expression of use that may occur without degradation of the physical resource and/or the intended experience opportunity of the users.

Supply coefficients were developed for dispersed recreation activities in each of the ROS classes. The following formula was used to generate these coefficients:

$$\text{RVD/AC/YR/PC} = \text{RVD/AC} \times \text{US} \times \text{LOS} \times \text{PU}$$

Where: **RVD/AC/YR/PC** = A dispersed recreation use production coefficient expressed as the practical use capacity in recreation visitor days per acre per year.

RVD/AC = A per-acre use density in visitor days for a 100-day period. This density value applies to the area of coincidence between one of five ROS classes and one of three Forest land suitability classes having slopes of less than 60 percent.

US = A multiplier to adjust the per-acre use density for use seasons greater or less than 100 days in length.

LOS = A value that expresses the average length of time a user would remain engaged in recreation activities within an ROS class setting.

PU = A value that reflects the relationship between the average weekend and weekday pattern of use in dispersed areas.

The per-acre use density values in the formula (RVD/AC) derive from Table 10 in the ROS User's Guide (FSH 2309.09). However, rather than utilizing only the values provided for the coniferous Forest eco-region, a range of values were used. The values selected for use were those by eco-region that are correlated with three general land suitability categories of the west side Douglas-fir type in the Willamette National Forest.

Correlation by land suitability class permits calculating an ROS class capacity in a manner that recognizes the relationship between the physical nature of the landscape and the kind of opportunity to be provided. That is to say, the more densely forested land types are typically able to accommodate more visitors

per acre than nonforested land types, and maintain a desired recreation experience. The correlation is illustrated in Table B-17.

Season of use values (US) are expressed as multipliers since RVD/AC density values from the ROS User's Guide are based on a 100-day use season. The use of a multiplier ensures accounting for use capacity for periods greater or less than 100 days in length. Determination of the use season duration and respective multipliers is based on the assumptions that work and leisure time patterns of use, agency regulations, and local or regional weather patterns each influence the actual length of the recreation use season. The extent of influence these factors have upon the use season is based upon the judgement of resource management specialists. Use season durations were expressed in actual days for each Ranger District by ROS class. District values were summed by ROS class and divided by seven to determine a Forest-wide average.

Length of stay (LOS) values used in calculating practical capacity for dispersed ROS classes were also obtained from the Districts. Values were expressed in hours for the length of time users would remain, on the average, within one of the ROS settings. The judgement of field managers in determining these values is based upon use surveys and their observational experience of user behavior for a variety of dispersed recreational activities. District values were summed for each class and divided by seven to determine LOS averages for the Forest. These values were then divided by 12 to derive an RVD equivalent LOS value for each ROS class.

Table B-17. ROS Class Use Density Correlation

Correlation Categories		ROS Class Use Density Coefficients ¹				
Land Class	Eco-Region ¹	P	SPN	SPM	RN	RM ²
Non-Forest Land	Tundra	0.45	1.05	2.4	6.0	6.0
Suited Forest Land	Coniferous Woodland	1.05	2.40	6.0	15.0	10.0
Unsuited Forest Land	Coniferous Woodland	0.75	1.72	4.2	10.5	8.0
Unsuited Forest Land	Evergreen Woodland	0.75	1.72	4.2	10.5	8.0
Unsuited Forest Land	Deciduous Forest	0.75	1.72	4.2	10.5	8.0
Non-Forest Land	Grassland	0.45	1.05	2.4	6.0	6.0
Non-Forest Land	Desert Shrub	0.45	1.05	2.4	6.0	6.0
Non-Forest Land	Lava Flows/Gypsum	0.4	1.05	2.4	6.0	6.0
Suited Forest Land	Riparian	1.05	2.40	6.0	15.0	10.0

¹ From ROS Users Guide, Table 10, p. 38. Values are RVDs/Ac/100-day season.

² Use Densities for the Roaded Modified Class are assumed to be similar to those of the Roaded Natural Class. This assumption is based on recent Research, by Roger N. Clark et al., that addresses dispersed roaded recreation in the PNW.

Pattern of use ratios for weekday to weekend use were obtained from the Districts and expressed as decimal factors for each District, based upon Table 9 from the ROS User's Guide (FSH 2309.13). Pattern of use values represent the relationship between the number of users for an average single weekday and an average single weekend day. These values, based upon dispersed use records and resource managers experience, were summed and divided by seven to determine an average pattern of use adjustment factor for the Forest.

The final major step was to compare capacity estimates with demand projections, both expressed on a per acre basis. Whichever coefficient was smaller was used as the projected use coefficient.

Similar procedures were followed for generating use coefficients for developed recreation and Wilderness use. Detailed documentation of these procedures is available in the planning records.

ECONOMIC EFFICIENCY ANALYSIS

This section describes cost-efficiency criteria and explains how net public benefits are measured. The analysis is required by NFMA regulations (36 CFR 219) and plays an important part in the development, comparison, and selection of Forest planning alternatives. The results of the assumptions and procedures discussed in this section are displayed in Chapter II of the FEIS and later in this appendix, *Analysis Prior to Development of Alternatives* and *Estimating Effects* sections.

Net Public Benefits

Maximization "of net public benefits in an environmentally sound manner" (36 CFR 219.1(a)) is a goal of the Forest planning process. Net public benefits are the "overall long-term value to the nation of all outputs and positive effects (benefits) less all the associated Forest inputs and negative effects (costs) whether they can be quantitatively valued or not" (36 CFR 219.3). Net public benefits represents the sum of the net value of priced outputs plus the net value of nonpriced outputs. Net public benefits cannot be expressed as a numeric quantity because the net value of priced outputs and effects cannot be added to qualitatively valued nonpriced outputs and effects.

Economics attempts to estimate the benefits and costs associated with all management options for planning National Forest management; in reality, it is very difficult to obtain adequate data for estimating either the costs involved in the production of Forest outputs or the benefits of many of the Forest resources. This is especially true when making estimates for a distant future such as 50-150 years. As a result, different procedures are used to estimate benefits and costs, and there are several resources or indirect costs which cannot be adequately addressed in the benefit and cost calculations. This does not mean that these are not important or are ignored in the Forest planning process, but that economics is unable to develop methods of recognizing them in estimates of efficiency. These are considered to be nonpriced benefits or costs. While they are not considered in measures of economic efficiency, they are considered in the evaluation of net public benefits.

Present Net Value

The primary criterion for measuring the value of the Forest is present net value (PNV) (FSM 1971.3). PNV represents the dollar difference between the discounted value of all outputs to which monetary values are assigned and the discounted cost of managing the Forest for the next 150 years. Priced outputs include market resources (timber, recreation special uses, recreation user fees, grazing, land uses, power, and minerals) as well as nonmarket resources (developed, dispersed and wilderness recreation, including recreation associated with wildlife and fish habitat).

The PNV calculated in FORPLAN was added to the discounted benefits and costs not modeled in FORPLAN. The total PNV was the primary indicator used to evaluate the overall economic efficiency of the benchmarks and alternatives. The benefits and costs not included in FORPLAN were those which do not significantly influence and are not significantly influenced by management prescription assignment and output scheduling in FORPLAN, and those deemed to be better modeled outside FORPLAN to achieve a feasible schedule (primarily road construction).

Parameters

Adjusting for Inflation

The timber values and costs actually used in the FORPLAN model and in data bases for those costs outside the model are in base year 1988 as this made the most sense to Forest personnel involved in developing these values and costs at that time. In the FEIS and associated appendices, benefits and costs are expressed in 1982 dollars to be consistent with the 1985 RPA Program analysis (FSM 1970.74). The gross national product implicit price deflator index as reported in the Economic Report of the President (US Government Printing Office 1989) was used to adjust benefits and costs for inflation to the 1982 base (see Table B-19).

Discounting

A discount rate of 4% was used to convert all benefits and costs to a common point in time. The 4% rate approximates the return on investments for Aaa corporate bonds for the period 1960 to 1978 above the rate of inflation (Row et al 1981). It was used to formulate and evaluate all benchmarks and alternatives.

All costs and benefits were discounted from the midpoint of each decade.

Costs

Costs were estimated for the 150-year period for the benchmarks and alternatives for all management activities. This discussion explains how costs were developed, the major expenditure categories, and funding sources. Table B-18 displays the management activities and how they are classified and modeled.

Cost Development and Modeling Process

Costs were reviewed and revised between the DEIS and FEIS to reflect current practices and the current accounting system. The costs developed in the draft were based on the Management Information Handbook (MIH) coding system. This system has been replaced by the National Activity Structure Handbook (FSH 1309.16). The cost structure was set up to be similar to the codes used by Forest Service managers in developing outyear budgets. The new cost information was incorporated in Alternatives K, A, J, W, D, and L, and the Timber and PNV benchmarks for the FEIS.

Costs for each resource management program were developed by Forest personnel in conjunction with developing standards and guidelines for management prescriptions. Resource specialists and Forest staff estimated costs for all activities based on historical data and professional judgement of any changes needed to meet the intent of the alternative. The costs represent the minimum funds needed to achieve the standards and guidelines in the management prescriptions. Costs include both direct costs of resource management and resource coordination costs to produce primary outputs in an environmentally acceptable way and/or mitigate short-term impacts. Costs were assumed to occur at the midpoint of each planning decade. The figures are calculated as average annual costs over each decade.

Three types of costs were estimated: fixed Forest Service costs, variable Forest Service costs, and purchaser costs. **Fixed costs** are the costs which do not vary over time within an alternative. Fixed costs were allowed to change between alternatives to reflect changes in the scale of management emphasis for each alternative. For example, more costly mitigation measures may be needed for alternatives which emphasize timber production. Many of the fixed costs are necessary to meet legal requirements

ECONOMIC EFFICIENCY ANALYSIS

of ensuring public safety and environmental protection. The others are those which would not significantly effect the FORPLAN results and had no direct relation to the timber harvest levels. These costs were estimated by resource specialists and Forest staff as the least cost estimates needed to meet the intent of the alternative being analyzed. Fixed costs are identified in Table B-18 under the column "Cost Type." This table also shows how these costs were allowed to vary between alternatives.

Variable costs vary with the output level of each benchmark or alternative. They include capital investments and operational costs. Variable costs are modeled as either FORPLAN costs or as "variable-other" costs. These are identified in Table B-18 under the column "Cost Type." FORPLAN variable costs are those which vary directly with the level of timber production and are used in the FORPLAN model. "Variable-other" costs will vary over time within an alternative. Most of the "variable-other" costs are those associated with road construction and reconstruction." Each management prescription has a unique set of variable costs.

Purchaser costs are those needed for logging and transporting logs to the mill. Logging system costs were developed for three logging system groups: ground, skyline, and aerial. Each of the FORPLAN Level 1 watersheds was analyzed to determine acres of suitable ground in each of the three logging system groups and an average logging cost was applied.

The average annual costs for 1st, 2nd and 5th decades and the discounted costs for the 150-year period are displayed for the benchmarks and alternatives in several tables in Chapter II of the FEIS. Also see the section, *Estimating Effects*, in this appendix.

Cost Categories and Funding Sources

Costs were identified as either operations and maintenance (OM) (the cost of planning and managing existing resources and assets) or as investment (the cost of creating or enhancing assets). Investments on the Forest include roads, wildlife improvements, reforestation, recreation facilities including trails, and administrative facilities. Major operations and maintenance costs are for planning, maintenance, long-term protection, and administration. These costs are identified in Table B-18 under the column labeled "Cost Class."

Real Cost Changes

Costs are assumed to remain constant relative to inflation over the 150-year planning period. However, the average unit costs of many activities may change over time as different types of treatment are implemented. For example, the average sale preparation costs are expected to increase when the proportion of timber harvest volume coming from commercial thinning increases.

Table B-18. Cost Class by Activity

Activity	Description	Units	Cost Class	Cost Type
AC	Cultural Resource Activities	ACRES	OM	FORPLAN
AN11	Recreation Resource Prep	per year	OM	FIXED
AN12	Recreation Resource Planning	per year	OM	FIXED
AN121	Recreation Sites & Facilities Planning	per year	OM	FIXED
AN22	Recreation Resource Imprvmnt Constructn	per year	INV	FIXED
AN23	Rec Res Imprv Maint	per year	OM	FIXED
AT11	Trail Preparation	per year	OM	FIXED
AT12	Trail Administration	per year	OM	FIXED
AT12	Trail Monitoring	per year	OM	FIXED
AT22	Trail Construction	per year	INV	FIXED
AT23	Trail Maintenance	per year	OM	FIXED
AV	Visual Resource Activities	per year	OM	FIXED
AW11	Wilderness Resource Preparation	per year	OM	FIXED
AW12	Wilderness Resource Administration	per year	OM	FIXED
AW121	Wilderness Resource Monitoring	per year	OM	FIXED
ET113	Timber Resource Coordination	ACRES	OM	FORPLAN
ML	Land Management Planning Activities	per year	OM	FIXED
PL132	Law Enforcement (Forest Service)	per year	OM	FIXED
CF1	Fish Operations	per year	OM	FIXED
CF121	Fish Habitat Monitoring	per year	OM	FIXED
CF221-KV	Fish Habitat Improv-Structures-CWKV	per year	INV	FIXED
CF221-NF	Fish Habitat Improv-Structures-NFWF	per year	INV	FIXED
CF2221	Resident Fish Non-Structural Improvement	per year	INV	FIXED
CF2222	Anadromous Fish Non-Structural Imprvmnt	per year	INV	FIXED
CF23	Fish Habitat Improvement Maintenance	per year	OM	FIXED
CT1	T&E Operations	per year	OM	FIXED
CT121	T&E Habitat Monitoring	per year	OM	FIXED
CT221	T&E Structural Habitat Improvement	per year	INV	FIXED
CT222	T&E Non-Structural Improvement	per year	INV	FIXED
CW1	Wildlife Operations/Planning	per year	OM	FIXED
CW121	Wildlife Habitat Monitoring	per year	OM	FIXED
CW221	Wildlife Habitat Structural Improvements	per year	INV	FIXED
CW222	Wildlife Habitat Non-Structurl Imprvmnts	per year	INV	FIXED
CW23	Wildlife Habitat Improvement Maintenance	per year	OM	FIXED
ET113	Timb Resource Coord	ACRES	OM	FORPLAN
ML	Land Management Planning Activities	per year	OM	FIXED
PL132	Law Enforcement (Forest Service)	per year	OM	FIXED
DN1	Range Resource Operations	per year	OM	FIXED
DN221	Range Resource Structural Improvements	per year	INV	FIXED
DN222	Range Resource Non-Structrl Improvements	per year	OM	FIXED
DN24	Noxious Farm Weeds	per year	OM	FIXED
ET1112	Silvicultural Examination & Rx	ACRES	OM	FORPLAN
ET112	Timber Resource Planning	ACRES	OM	FORPLAN
ET114	Timber Sale Preparation	ACRES	OM	FORPLAN
ET114x	Tbr Sale Prep - Roadless Entry + Pub Aff	per year	OM	FIXED
ET12	Timber Harvest Administration	ACRES	OM	FORPLAN
ET12xx	Timb Admin - Reservoir Sweeping	per year	OM	FIXED
ET24	Reforestation (ET241-244)	ACRES	INV	FORPLAN

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Table B-18 Cont. Cost Class by Activity

Activity Description		Units	Cost Class	Cost Type
ET251	TSI-Release & Weeding	ACRES	INV	FORPLAN
ET252	TSI-Precommercial Thinning	ACRES	INV	FORPLAN
ET253	TSI-Pruning	per year	OM	FIXED
ET255	TSI-Fertilization	ACRES	INV	FORPLAN
ET27	Genetic Tree Activities	per year	INV	FIXED
ML	Land Management Planning Activities	per year	OM	FIXED
PL132	Law Enforcement Activities	per year	OM	FIXED
ET113	Timber Resource Coordination	ACRES	OM	FORPLAN
FA121	Air Quality Monitoring (for Wilderness)	per year	OM	FIXED
FW1	S&W Admin/Monitor FW111/FW112/FW12	per year	OM	FIXED
FW111	Watershed Resource Inventory(Soil&Water)	per year	OM	FIXED
FW112	Watershed Resource Planning	per year	OM	FIXED
FW12	Watershed Resource Administration	per year	OM	FIXED
FW121	Watershed Resource Monitoring	per year	OM	FIXED
FW22	Watershed Resource Imprvmnt Construction	per year	INV	FIXED
FW23	Watershed Resource Imprvmnt Maintenance	per year	OM	FIXED
FW23-KV	Watershed Resource Imprvmnt Maint- CWKV	per year	OM	FIXED
FW23-NF	Watershed Resource Imprvmnt Maint- NFWF	per year	OM	FIXED
ML	Land Management Planning Activities	per year	OM	FIXED
ET113	Timber Resource Coordination	ACRES	OM	FORPLAN
GM1	Minerals & Geology Resource Prep&Admin	per year	OM	FIXED
ML	Land Management Planning Activities	per year	OM	FIXED
PL132	Law Enforcement (Forest Service)	per year	OM	FIXED
AC	Cultural Surveys for Land Exchange	ACRES	OM	VAR-OTH
CT1	T&E Surveys for Land Exchange	ACRES	OM	VAR-OTH
JL111	Lands Inventory	per year	OM	FIXED
JL122	Special Use (S/U) Administrtrn (non-rec.)	per year	OM	FIXED
JL123	Land Ownership Administration	per year	OM	FIXED
JL23	Lands Activity Maintenance	per year	OM	FIXED
JL24	Landline Location	per year	INV	VAR-OTH
JL26	Land Ownership Adjustments	per year	OM	FIXED
PL132	Law Enforcement (Forest Service)	per year	OM	FIXED
L05.0_A	5.0 Augmentation-Timber-Constructuion	per year	OM	FIXED
L05.0_B	5.0 Augmentation-Timber-Reconstruction	per year	OM	FIXED
L07.0_A	7.0 Transp Admin-Gen Purp-Construction	per year	OM	FIXED
L07.0_B	7.0 Transp Admin-Gen Purp-Reconstruction	per year	OM	FIXED
L07.0_C	7.0 Transp Admin-Recreation-Construction	per year	OM	FIXED
L07.0_D	7.0 Transp Admin-Recreation-Reconstruct	per year	OM	FIXED
L07.0_E	7.0 Transp Admin-Timber-Construction	per year	OM	FIXED
L07.0_F	7.0 Transp Admin-Timber-Reconstruction	per year	OM	FIXED
L08.0_A	8.0 Program Support-Gen Purp-Construct	per year	OM	FIXED
L08.0_B	8.0 Program Support-Gen Purp-Reconstruct	per year	OM	FIXED
L08.0_C	8.0 Program Support-Recreation-Construct	per year	OM	FIXED
L08.0_D	8.0 Program Support-Recreation-Reconstr	per year	OM	FIXED
L08.0_E	8.0 Program Support-Timber-Construction	per year	OM	FIXED
L08.0_F	8.0 Program Support-Timber-Reconstruct	per year	OM	FIXED
L08.3_A	8.3 Forest Planning-Gen Purp-Constr	per year	OM	FIXED
L08.3_B	8.3 Forest Planning-Gen Purp-Reconstr	per year	OM	FIXED
L08.4_A	8.4 Law Enforcemnt-Gen Purp-Constr	per year	OM	FIXED
L08.4_B	8.4 Law Enforcemnt-Gen Purp-Reconstr	per year	OM	FIXED

Table B-18 Cont. Cost Class by Activity

Activity	Description	Units	Cost Class	Cost Type
L08.5_A	8.5 ROW Support-Timber-Construction	per year	OM	FIXED
L08.5_B	8.5 ROW Support-Timber-Reconstruction	per year	OM	FIXED
L11TBCON	11.0 PCP Road C/R-Timber-Construction	Miles	INV	VAR-OTH
L11TBREC	11.0 PCP Road C/R-Timber-Reconstruction	Miles	INV	VAR-OTH
L12TBREC	12.0 PCP Bridge C/R-Timber-Reconstruct	Bridge	INV	VAR-OTH
L1GENCON	1.0 Construction-Gen Purpose-Constructn	Miles	INV	VAR-OTH
L1GENRCN	1.0 Construction-Gen Purpose-Reconstruct	Miles	INV	VAR-OTH
L1RECCON	1.0 Construction-Recreation-Construction	Miles	INV	VAR-OTH
L1RECREC	1.0 Construction-Recreation-Reconstructn	Miles	INV	VAR-OTH
L1TBRCON	1.0 Construction-Timber-Construction	Miles	INV	VAR-OTH
L1TBRREC	1.0 Construction-Timber-Reconstruction	Miles	INV	VAR-OTH
L21TBCON	21.0 PEP Road C/R-Timber-Construction	Miles	INV	VAR-OTH
L21TBREC	21.0 PEP Road C/R-Timber-Reconstruction	Miles	INV	VAR-OTH
L2TBRCON	2.0 Rights-of-way-Timb-Construction	ROW Case	INV	VAR-OTH
L3GENCON	3.0 Const Eng-Gen Purpose-Construction	Miles	INV	VAR-OTH
L3GENREC	3.0 Const Eng-Gen Purpose-Reconstruct	Miles	INV	VAR-OTH
L3RECCON	3.0 Const Eng-Recreation-Construction	Miles	INV	VAR-OTH
L3RECREC	3.0 Const Eng-Recreation-Reconstruction	Miles	INV	VAR-OTH
L3TBRCON	3.0 Const Eng-Timber-Construction	Miles	INV	VAR-OTH
L3TBRREC	3.0 Const Eng-Timber-Reconstruction	Miles	INV	VAR-OTH
L4GENCON	4.0 Pre-Constr Eng-Gen Purp-Construction	Miles	INV	VAR-OTH
L4GENREC	4.0 Pre-Constr Eng-Gen Purp-Reconstruct	Miles	INV	VAR-OTH
L4RECCON	4.0 Pre-Constr Eng-Recreate-Construction	Miles	INV	VAR-OTH
L4RECREC	4.0 Pre-Constr Eng-Recreate-Reconstructn	Miles	INV	VAR-OTH
L4TBRCON	4.0 Pre-Constr Eng-Timb-Construction	Miles	INV	VAR-OTH
L4TBRREC	4.0 Pre-Constr Eng-Timb-Reconstruction	Miles	INV	VAR-OTH
L6TBRREC	6.0 Bridges-Timber-Reconstruction	Bridge	INV	VAR-OTH
LF1/LF2	Facility Activities/Improvements	per year	INV	FIXED
LF22	Facility Construction	per year	INV	FIXED
LF22VIS	15 Visitor Centers (2, shared 6 ways)	per year	INV	VAR-OTH
LF23	Facility Maintenance	per year	OM	FIXED
LG	Geometronics Activities	per year	OM	FIXED
LQUARTER	Quarters	per year	OM	FIXED
LT23	Road Maintenance	per year	OM	VAR-OTH
PL132	Law Enforcement (Forest Service)	per year	OM	FIXED
ML	GIS Data Acquisition & Updating	per year	INV	FIXED
ET113	Timber Resource Coordination	ACRES	OM	FORPLAN
ML	Land Management Planning Activities	per year	OM	FIXED
PF11	Fire Management Preparation	per year	OM	FIXED
PF2	Fuels Improvements	ACRES	OM	FORPLAN
PL121	Regular CLE Agreements	per year	OM	FIXED
PL122	Cannabis CLE Agreements	per year	OM	FIXED
PL131	Drug Control (Non-Cooperative)	per year	OM	FIXED
PL132	Law Enforcement (Forest Service)	per year	OM	FIXED
TG4	Program Support	per year	OM	FIXED
TG3	Line Support	per year	OM	FIXED
TG4	Program Support	per year	OM	FIXED
FLC	Fixed Log Cost	ACRES	PC	PURCHASE
VLC	Variable Log Cost	MCF	PC	PURCHASE

Benefit Values

Benefits were estimated for a 150 year period for the benchmarks and alternatives for outputs that are or could be exchanged in the marketplace: timber harvest, recreational special uses, recreational user fees, grazing, land uses, power, minerals and the full spectrum of recreational opportunities (from fully developed to wilderness). The values reflect the potential dollar return even though money may not actually be collected. Benefits were assumed to occur at the midpoint of each planning decade. The benefits are calculated as average annual benefits for each decade. This section explains the methods used to estimate current and future values for Forest outputs.

Timber Values

The base timber values for the Forest were obtained from the Timber Statement of Accounts data base. These values represent high bid stumpage by species for volume harvested from Forest sales over an eleven year period - April 1977 to September 1988. See Figures B-1 to B-4 for an overview of how these values have varied for each species within each of the four timber types used. The timber values and costs used in the FORPLAN model are in base year 1988 as this made the most sense to Forest personnel involved in developing these coefficients at that time. All values displayed in the FEIS were then converted to base year 1982 dollars using GNP implicit price conversion factors (see Table B-19). Economic costs and values are displayed in base year 1982 to be consistent and allow comparison with other Forest FEIS's in Region 6.

Real Price Changes - The demand of the economy for different goods and services and the ability of the economy to produce these goods will actually determine the price of any particular item. The interaction of demand and supply will determine both the price of the item and the quantity exchanged. When demand for a good rises (falls) and the ability of the economy to produce the good remains the same, prices will rise (fall). When a change such as this manifests itself over time and the price of a good changes at a rate significantly different from the change in prices of the economy as a whole, a real price change has occurred. For estimating projections of future costs and benefits, the Forest assumed, based upon Regional direction, that there will not be real price changes, except for the value of timber stumpage. This value is assumed to experience a 1% real price increase annually from decade one to decade five. This price trend assumption is based both upon historic evidence and likely scenarios of future markets. Since stumpage is not directly represented in the Forest's FORPLAN model, and pond values are, this price trend is applied both to pond value and logging costs (the difference between pond value and logging costs is stumpage value). The implications of this price trend assumption are described in the *Analysis Prior to the Development of Alternatives* later in this Appendix.

Price-Quantity Relationships - The prices assigned to resource outputs were not related to outputs levels unless outputs levels exceeded projected use (i.e., demand schedules are assumed to be horizontal for the range of outputs explored in the benchmarks and alternatives except for certain types of recreation opportunities). The demand for timber is assumed to be horizontal (Sirmon 1983).

The process used to obtain the desired pond values in dollars per MCF for existing and managed stands is as follows:

1. The base stumpage values were combined into timber types by taking a volume-weighted average of the appropriate species. Table B-20 contains the results of this exercise.

2. Forest-wide average logging costs and manufacturing costs were calculated (based on 2400-17 Timber Data) and were added to the stumpage values to obtain manufacturing values by timber type. Table B-21 displays these results.
3. Volume-weighted price-diameter relationships were developed for the Douglas-fir/western hemlock and Douglas-fir/true fir timber types using tables adapted from work done by Snellgrove and Cahill at the PNW Experiment Station (see 4/27/84 Regional Forester's Directive, subject "Economic Analysis Revision of November 10, 1983, Regional Direction Package). The index for lodgepole pine was used for the mountain hemlock type. Table B-22 contains the price-diameter indices for the timber types.
4. The average manufacturing values by timber type were assigned to the index diameter which represented the average group diameter from a sample of approximately 100 active timber sales on the Forest. Manufacturing values by diameter were calculated.
5. Average manufacturing costs were subtracted from the manufacturing values by diameter to get pond value or mill values by diameter.
6. Board-foot to cubic-foot conversion ratios by diameter for existing and managed stands were applied to pond value to get \$/MCF. Table B-23 contains the results of steps 4 to 6.

Pond values by timber types and diameter were used in FORPLAN to allow the model to select between analysis areas with differing logging costs. The net of pond values minus logging costs, commonly referred to as "stumpage", represents an economic value collected as a cash receipt.

Figure B-1. Values of Species in Douglas Fir/True Fir

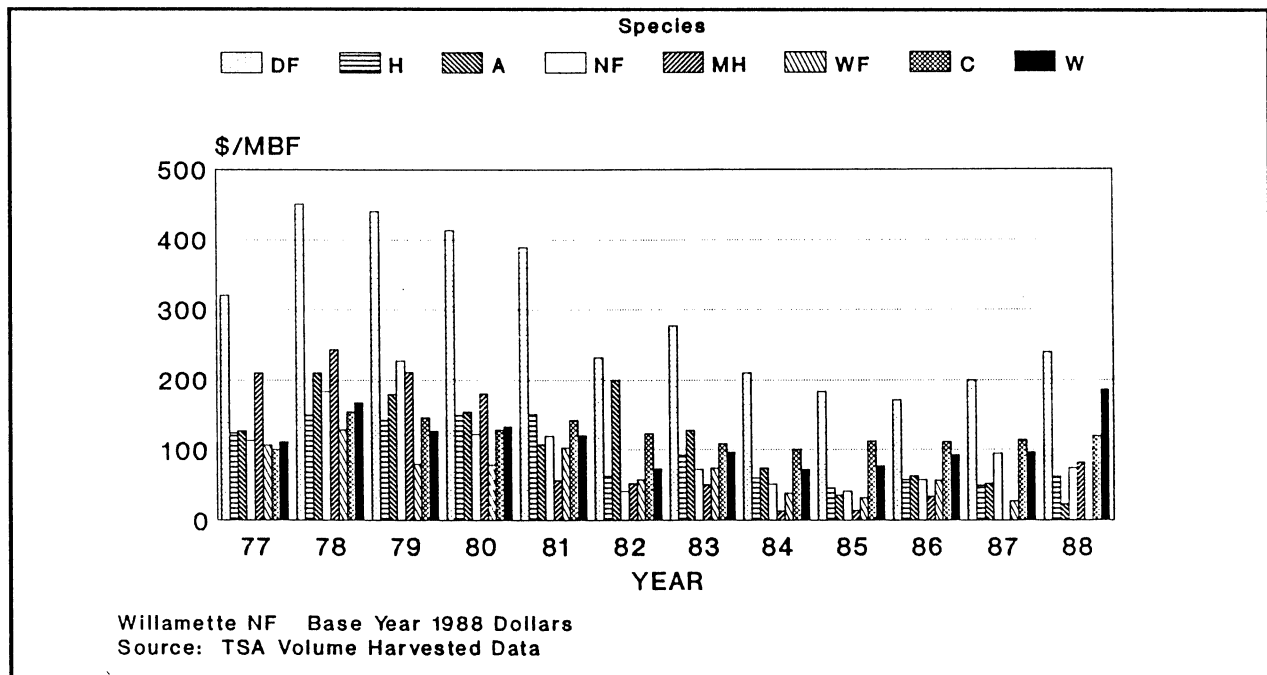


Figure B-2. Values of Species in Douglas Fir/Hemlock

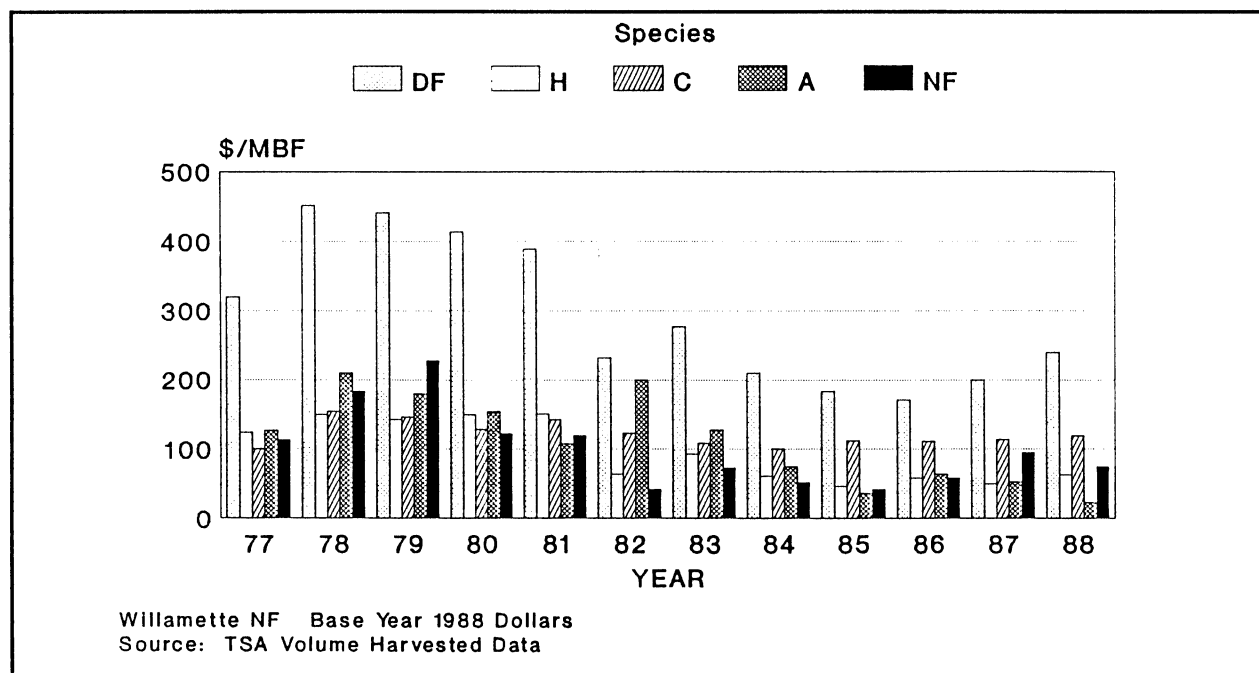


Figure B-3. Values of Species in True Fir

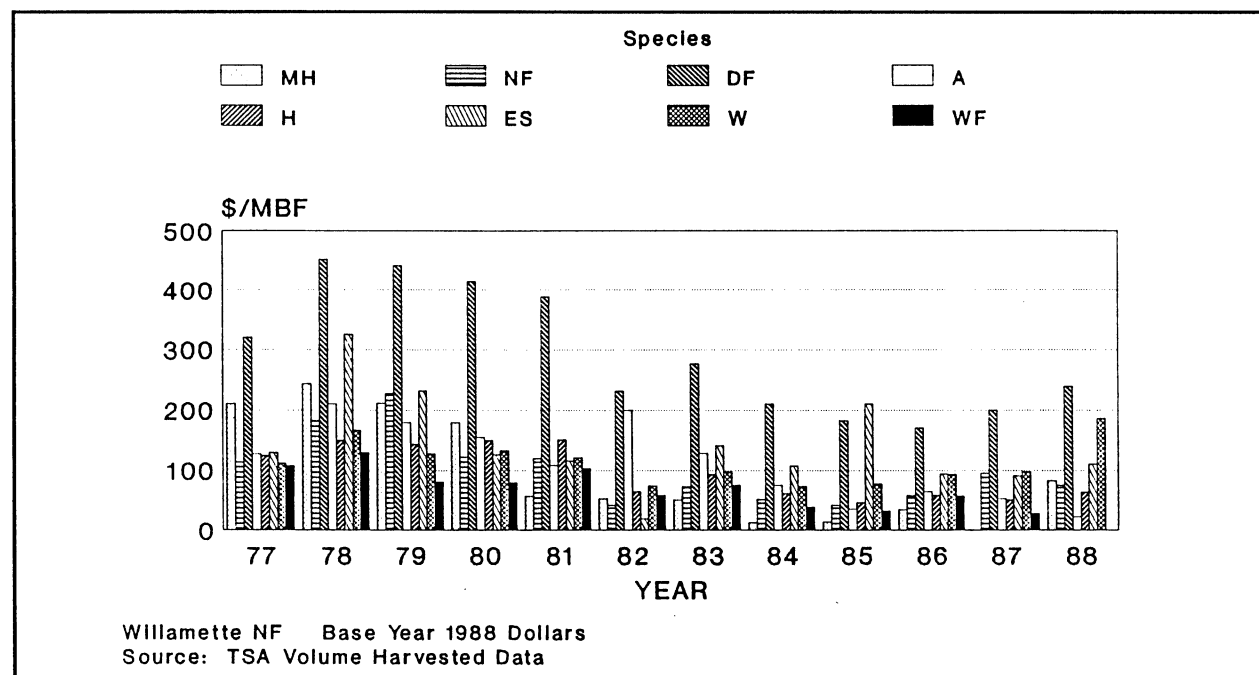
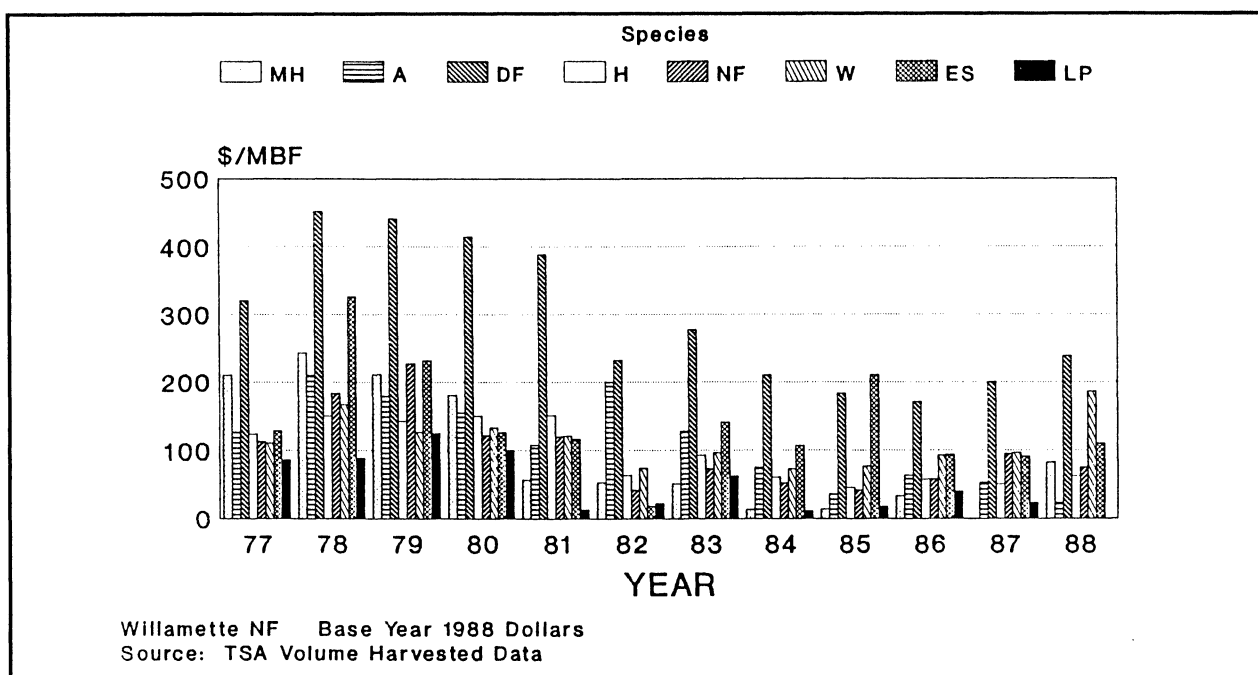


Figure B-4. Values of Species in Mountain Hemlock**Table B-19. GNP Implicit Price Conversion Factors**

Fiscal Year	Index
1982	100.00
1983	103.83
1984	106.88
1985	110.73
1986	113.84
1987	116.13
1988	119.94
1989	125.12
1990	130.12 ¹

¹ Estimated by assuming 4% inflation for 1990.

ECONOMIC EFFICIENCY ANALYSIS

Table B-20. Timber Type Values (Appendix B)

Timber Type	Species	Proportion of Volume	\$/MBF	Composite Value
Douglas fir/western hemlock western hemlock	Douglas fir	0.76	235.19	178.74
	Western hemlock	0.16	82.57	13.21
	Western redcedar	0.04	99.25	3.97
	Pacific silver fir	0.02	95.08	1.90
	Noble fir	0.02	80.06	1.60
				----- 199.43
Douglas fir/true fir	Douglas fir	0.55	235.19	129.35
	Western hemlock	0.16	82.57	13.21
	Pacific silver fir	0.11	95.08	10.46
	Noble fir	0.09	80.06	7.21
	Mountain hemlock	0.03	75.89	2.28
	White fir	0.03	80.06	2.40
	Western redcedar	0.02	99.25	1.98
	Western white pine	0.01	97.58	0.98
				----- 167.87
True fir	Mountain hemlock	0.26	75.89	19.73
	Noble fir	0.24	80.06	19.22
	Douglas fir	0.16	235.19	37.63
	Pacific silver fir	0.16	95.08	15.21
	Western hemlock	0.13	82.57	10.73
	Engelmann spruce	0.02	116.76	2.34
	Western white pine	0.02	97.58	1.95
	White fir	0.01	80.06	0.80
				----- 107.61
Mountain hemlock	Mountain hemlock	0.37	75.89	28.08
	Pacific silver fir	0.29	95.08	27.57
	Douglas fir	0.15	235.19	35.28
	Western hemlock	0.08	82.57	6.61
	Noble fir	0.07	80.06	5.60
	Western white pine	0.02	97.58	1.95
	Engelmann spruce	0.01	116.76	1.17
	Lodgepole pine	0.01	50.87	0.51
				----- 106.77

Table B-21. Manufacturing Values \$/MBF (Appendix B)

Timber Type	High Bid Stumpage	Average Logging Costs	Manufacturing Costs	Manufacturing Value
Douglas fir/Western hemlock	199.43	107.59	147.62	454.63
Douglas fir/True fir	167.87	107.59	147.62	423.07
True fir	107.61	107.59	147.62	362.82
Mountain hemlock	106.77	107.59	147.62	361.97

Note: Average Logging Cost and Manufacturing Cost are from 2400-17
Timber Data for the Forest, for the years 1984 to 1988.

Table B-22. Price-Diameter Indices

DBH	Douglas fir/ Western hemlock	Douglas fir/True fir	True fir	Mountain hemlock
8	64	59	73	79
10	68	64	77	89
12	73	69	81	96
14	77	73	84	100
16	81	78	87	
18	85	82	90	
20	88	86	92	
22	90	88	Avg.--> 94	
24	92	90	96	
26	93	92	98	
28	Avg.--> 93	93	99	
30	95	Avg.--> 94	100	
32	95	95		
34	95	95		
36	96	97		
38	98	99		
40	98	100		

ECONOMIC EFFICIENCY ANALYSIS

Table B-23. Values by Timber Type

				Managed		Existing	
DBH	Index	Mfg. Value \$/MBF	Pond Value \$/MBF	BF/CF	Pond Value \$/MCF	BF/CF	Pond Value \$/MCF
Douglas fir/Western Hemlock							
8	64	313	165	2.34	387	4.22	697
10	68	332	185	2.34	432	5.02	928
12	73	357	209	3.30	690	5.02	1050
14	77	376	229	3.93	899	5.02	1149
16	81	396	248	4.54	1128	5.02	1247
18	85	416	268	4.64	1243	5.02	1345
20	88	430	283	4.87	1376	5.02	1418
22	90	440	292	5.16	1509	5.84	1707
24	92	450	302	5.16	1559	5.84	1764
26	93	455	307	5.49	1685	5.84	1793
28 ¹	93	455	307	5.49	1685	5.84	1793
30	95	464	317	5.49	1739	5.84	1850
32	95	464	317	5.49	1739	5.84	1850
34	95	464	317	5.49	1739	5.84	1850
36	96	469	322	5.49	1766	5.84	1879
38	98	479	331	5.49	1820	5.84	1936
40 +	98	479	331	5.49	1820	5.84	1936
Douglas fir/True fir							
8	59	266	118	2.08	245	4.04	476
10	64	288	140	2.08	292	5.14	722
12	69	311	163	3.26	531	5.14	837
14	73	329	181	3.83	693	5.14	930
16	78	351	203	4.10	834	5.14	1046
18	82	369	221	4.47	990	5.14	1138
20	86	387	239	4.49	1075	5.14	1231
22	88	396	248	4.72	1173	5.72	1421
24	90	405	257	4.77	1228	5.72	1473
26	92	414	266	5.53	1473	5.72	1524
28	93	419	271	5.53	1498	5.72	1550
30 ¹	94	423	275	5.53	1523	5.72	1576
32	95	428	280	5.53	1548	5.72	1601
34	95	428	280	5.53	1548	5.72	1601
36	97	437	289	5.53	1598	5.72	1653
38	99	446	298	5.53	1648	5.72	1704
40 +	100	450	302	5.53	1673	5.72	1730
True fir							
8	73	282	134	3.75	503	4.93	661
10	77	297	150	3.75	561	5.09	761
12	81	313	165	3.75	619	5.09	840
14	84	324	177	4.03	712	5.09	899
16	87	336	188	4.23	796	5.09	958
18	90	347	200	4.42	883	5.09	1017
20	92	355	207	4.63	961	5.09	1056
22 ¹	94	363	215	4.89	1052	5.37	1156
24	96	371	223	5.03	1121	5.37	1197
26	98	378	231	5.10	1176	5.37	1239
28	99	382	234	5.26	1233	5.37	1259
30 +	100	386	238	5.45	1299	5.37	1280
Mountain hemlock							
8	79	286	138	3.92	542	4.35	602
10	89	322	175	3.92	684	4.99	871
12	96	347	200	3.92	784	4.99	997
14 + ¹	100	362	214	5.08	1089	4.99	1070

¹ These diameters represent the average value for each timber type.

Other Values That Generate Forest Revenues

The other values for which cash receipts are received are recreation special uses, recreation user fees, grazing, land uses, power, and minerals. The total returns for these values were averaged over the period 1985 to 1989. These receipts are a very small portion of the total returns to the Forest when compared to timber receipts. They also represent fairly stable uses and would not change significantly between alternatives. Therefore, the average values for these items were applied the same in all alternatives and benchmarks. The calculation of these values is displayed in Table B-24

Table B-24. Revenues Other Than Timber¹

	1985	1986	1987	1988	1989	Average
Recreation Special Uses	65.93	145.12	159.99	178.84	178.47	145.67
Recreation User Fees	127.61	117.45	93.95	112.14	145.86	119.40
Other						
Grazing	0.36	0.44	0.43	0.42	0.56	0.44
Land Uses	16.17	16.78	18.08	15.01	17.58	16.72
Power	0.72	0.18	0.34	1.75	0.72	0.74
Minerals	32.87	11.86	3.27	5.42	8.15	12.32
Subtotal Other						30.22
GRAND TOTAL						295.29

¹ In thousands of base year 1982 dollars.

Other Nonmarket Values

In addition to the priced outputs for which actual cash revenues are received by the Forest, there are several forms of recreation that have values applied. The values used were developed for the Pacific Northwest Region for the 1985 RPA program analysis. No value was assigned to any recreation capacities which exceeded expected demand. The values used for each type of recreation are displayed in Table B-25.

Table B-25. Nonmarket Recreation Benefits

ROS Class		
Recreation Type	Setting	Value \$/RVD
DEVELOPED	DEV	\$9.38
DISPERSED	SPN	\$13.25
	SPM	\$12.13
	RN	\$9.38
	RM	\$4.97
WILDERNESS	PRS	\$17.50
	PRM	\$17.50
	SPR	\$17.50
	TRN	\$17.50

DEV Developed
 SPN Semiprimitive Nonmotorized
 RN Roaded Natural
 RM Roaded Modified
 PRS Pristine
 PRM Primitive
 SPR Semiprimitive
 TRN Transition

Nonpriced Benefits

The calculation of PNV enables the comparison of alternatives with regards to their output levels for priced resources and their efficiency in producing them. However, other factors also influence the decision making process. In some cases the importance of nonpriced benefits for which it is impossible to assign monetary values can outweigh the advantages of producing higher levels of priced outputs. The importance of the need to consider these subjectively valued benefits in Forest management decision making is addressed in the NFMA Regulations which charge the Forest Service with identifying the Alternative which comes nearest to maximizing net public benefits (36 CFR 219.12(F)).

Net public benefits (NPB) represent the overall value to the nation of all outputs and positive effects (benefits) less all associated inputs and negative effects (costs), whether they can be quantitatively valued or not (36 CFR 219.3). Net public benefits include both priced and nonpriced resource outputs, less all costs associated with managing the area. As stated earlier, all priced outputs and all costs associated with managing the Forest are included in the calculation of PNV. To this, the net subjective values of the nonpriced outputs must be added in order to arrive at the overall NPB of an Alternative. Some of the most important nonpriced benefits addressed during the Forest planning process revolve around maintaining and enhancing the following:

- Lifestyles
- Diversity and quality of recreation opportunities
- Ecosystem diversity
- Old-growth and snag habitat
- Scenic quality
- Historical and cultural resources
- Air quality.
- Water Quality

These are all outputs and effects which are influenced to a large degree by decisions regarding how to manage the Forest. They are important, but it is not possible to measure their importance in dollar terms which are comparable to market values. Their values must be subjectively determined.

The provision for many of the nonpriced benefits is achieved by applying constraints to the production of priced outputs (such as timber harvesting constraints in FORPLAN). These constraints usually result in a decrease in the PNV of the priced outputs to which the constraints were applied. Subjective judgements are then necessary in assessing whether the benefits of producing the nonpriced outputs exceed the opportunity costs associated with producing fewer priced outputs. If a PNV tradeoff induced by the provision of a nonpriced output is judged acceptable, then a positive contribution to NPB has resulted; and the alternative is overall more efficient.

While the quantitative dollar values of each nonpriced benefit can not be determined, they can generally be evaluated by examining such quantitative indicators as acres of appropriate allocations, resource inventories, or timber production related activities and outputs.

SOCIAL AND ECONOMIC IMPACT ANALYSIS

Social and economic impact analysis examines the consequences of different land management decisions on the people and communities surrounding the Forest. The effect of the alternatives on local communities are measured in terms of Forest Service payments to local governments, changes in job and personal income in the local area, and changes in lifestyles and community structure. Economic analysis identifies the consequences in terms of employment, personal income, and payments to counties while social analysis focuses on changes in lifestyles and community structure within the different types of communities surrounding the Forest. Both types of analysis focus primarily on the consequences in the 1st decade.

This section describes the data and methods used to estimate the social and economic effects of the benchmarks and alternatives. First, the relationships between the Forest and the local communities are briefly discussed and the area of influence is described. Then the methods used to estimate the impact on jobs and income are summarized. Finally, the framework of the social analysis is discussed. See the previous section of this Appendix for a discussion of the assumptions and methods used to estimate Forest Service payments to county governments.

This discussion is supported by other discussions of the FEIS: the community issue in Chapters I and Appendix A, the description and comparison of the alternatives in Chapter II, the socio-economic setting in Chapter III, and the consequences of the alternatives on local communities in Chapter IV. Much of following was drawn from the *Willamette National Forest Socio-Economic Overview* (Peterson, 1983) on file in the Supervisors Office in Eugene, Oregon.

Overview

Like neighbors of most National Forests, many residents and communities in the surrounding area are partially dependent on the resources of the Willamette National Forest for their social and economic well-being. The main ties to the Forest are 1) economic (primarily timber harvest), 2) use of Forest resources off the Forest (e.g., downstream use of water and viewing the Forest from major highways), and 3) recreation opportunities

Area of Influence

The area considered in these impact analyses is known as the primary area of influence. The Forest's area of influence is defined to include the people who utilize or are affected by its resources. The major resources of the Forest include recreation opportunities, fish and wildlife, timber, and water. Each resource is used, processed, or consumed by different, though overlapping, segments of the population located in varying proximity to the Forest. The primary area of influence for the Willamette National Forest consists of Lane, Linn, and Marion counties.

The secondary area of influence includes eight counties that surround or are influenced by the resources from the Willamette National Forest: Clatsop, Columbia, Multnomah, Jefferson, Benton, Polk, Yamhill, Douglas, and Deschutes. These and other counties are marginally influenced by the management of the Forest. This is apparent in terms of recreation visitors and indirectly through use of lumber products. The many lakes on the Forest, the migrating Chinook salmon and steelhead that spawn on the Forest streams, as well as the pristine Wildernesses, draw thousands of persons from the western states and other counties. The measurable influence that the Forest management alternatives have on these distant persons, counties, or states is, however, almost impossible to calculate.

The percentage of a county located inside the Forest indicates the effect the Forest has on these counties. Lane county has the highest percentage of its lands within the Forest boundary at 34.8%. Linn county follows very close with 31.7% of the county inside the Forest. Marion county, which has many small towns highly dependent on the wood and wood products manufacturing, has 18.1% of its land within the Forest boundaries.

Most of the timber sold on the Forest is processed at mills in Lane, Linn, and Marion counties. A small amount is processed in Douglas County. Historically, the Forest has provided anywhere from 18 to 40% of the logs processed at mills in the three-county area.

Economic Impact Model

An input-output model of the three-county area (the primary area of influence) was used to estimate the employment and income effects of Forest outputs and activities.

Input-output Overview

Input-output analysis is based upon the interdependence of the production and consumption sectors in an impact area. Industries must purchase goods and services from other industries as well as pay salaries to employees. Purchases include primary materials, like natural resources, used to manufacture outputs which are sold either to other industries or to final consumers. The model is a matrix representation of buyers and sellers in an economy. This matrix of input-output accounts can be thought of as a picture of an area's economic structure.

Flows of industrial inputs can be traced through the input-output model to show linkages between the industries present in the economy. These flows are transformed into a set of simultaneous equations that are used to predict economic effects resulting from changes in Forest outputs and activities. For example, changes in the level of timber outputs would cause a change in the timber industry (direct effect), which would affect construction and other industries that buy from and sell to the timber industry (indirect effect). In addition, changes in these industries would trigger changes in other industries, especially in the sectors which provide goods and services to the employees (induced effect).

IMPLAN Data Base

The input-output model used was IMPLAN, which was developed by the Forest Service from the 1972 National input-output model, updated in 1977, and again in 1982. The economic effects predicted by IMPLAN include employment, income, and population. More information is found in *IMPLAN Software Manual* (Alward, et al 1989) and *IMPLAN Analysis Guide* (Palmer, Siverts, and Sullivan 1985).

IMPLAN contains national economic data that has been organized into a single predictive model. The basis for prediction can be any single U.S. county or group of counties, any state or states, or the entire nation. Regardless of how the model is constructed (county or multiples of counties), IMPLAN provides a detailed description of the economy in question. The model then provides analytical information about the industries that are present and their relationship to other industries. Thus, changes in any of the industries as caused by the alternatives will result in measurable changes in the socioeconomic area of influence.

The economic effects estimated with IMPLAN are described by parameters typical of input/output studies. They are structural in nature, permitting multiplier effects to be traced throughout the various regional sectors. Direct, indirect, and induced changes in gross outputs, employment, income, and value added are the most representative parameters used to describe effects. When combined, the information provides a comprehensive account of potential regional economic effects. This information can be used to portray the Forest's relationship to the area economy and to help assess the effects on that economy of alternative management programs (USDA Forest Service 1985).

The IMPLAN model consists of: (1) a data base of economic information, (2) several computer programs designed to access the data base and construct a county or group of counties for analysis, and (3) an analysis program designed to show the differences in economic effects of the various alternatives and a projection of their effects.

Assumptions-The IMPLAN data base consists of two major components: (1) the national technology matrix, and (2) estimates of the economic sectors for final demand, final payments, gross outputs, and employment for each county in the United States. The data base represents 1982 county information for 528 economic sectors. The national technology matrix was derived from the 1977 Department of Commerce national input/output model. This matrix is a representation of the national averages that have been estimated at the state and county levels. Though the IMPLAN data base has been updated with 1982 information, it still reflects the earlier economic sector relationships.

The IMPLAN model is designed to compare the effects of changes in the final demand for particular goods and services upon a number of different sectors of the economy. It compares changes created initially in the sector receiving the change in final demand (direct effect), and the sectors influenced by changes in spending of the initially affected sector (indirect effect). The IMPLAN model uses a national transactions table to trace this movement of spending through the different sectors of the economy. It uses data developed in 1982 on these national transactions with data from Lane, Linn, and Marion counties for the same year. Thus, two assumptions inherent in the use of IMPLAN are

that the Forest's area of influence exchanges its goods in a manner similar to the national economy, and that the local economic relationships have not changed sufficiently since 1982 to invalidate the projected effects based upon 1982 data.

Several other critical assumptions are made with respect to the methods used to estimate values for the particular factors used in the analysis. Most of these factors rely on an assumption of adequate demand existing to fulfill the estimated use or consumption of the resource. Since adequate demand has not existed in the recent past for all of these items, most estimates have been labeled as "potential" effects. In the event that all demand and other related assumptions were met, these would become the actual impact. Demand assumptions were critical to the estimates of effects associated with timber harvests, payments to counties, and recreation.

Related assumptions deal with the financial estimates associated with these items. Changes in harvest levels and payments to counties rely upon the assumptions that demand will exist and that the stumpage will be cut with the resulting final products sold for the prices estimated. Changes associated with recreation activity assume not only that the recreation activities will actually occur as estimated, but that expenditures will be made as estimated. Changes in Federal expenditures assume that budget allocations will be made according to the estimates presented in the alternative.

Final Demand Expenditures

An intermediate step in estimating employment and income effects is to translate Forest outputs into final demand expenditures. Outputs on the Forest that can cause significant changes in final demand are timber, various forms of recreational activity, Federal expenses, and payments to counties. Final demand expenditures represent the money spent by the final consumers of the products derived from forest outputs. These expenditures are identified by the sector in which the expenditures occur. These data were all expressed in 1982 dollars to be consistent with the IMPLAN data.

Final demand values for timber were estimated based upon the selling values used for final timber products in the timber sale appraisal process. This value was identified as \$453.82 per MBF in 1982 dollars appropriate for use in IMPLAN. This value reflects the product selling value after payments to the Federal Government are taken out. In theory this selling value would correspond to the change in final demand for timber.

Rather than attempting to separate the volume of timber from the Forest into the sawmill, veneer, and plywood sectors, these sectors were aggregated into a single sector. This sector receives the effects associated with changes in proposed harvest levels.

Another major category of Forest outputs influencing local economies are expenditures associated with recreation activities. A task force of economists in Region 6 developed a series of estimates of average expenditures associated with particular types of recreation activities. These major types of recreation activities were measured in terms of recreation visitor days (RVDs). For each activity category expenditures by specific IMPLAN sectors were estimated in 1982 dollars. Generally, each activity could be expected to divide its total expenditures among a number of different sectors. This would reflect expenses for food, gasoline, recreational equipment, etc.

To use these expenditures the Forest needed to estimate how much of its recreational use could be classified into each major group. From Recreation Information Management (RIM) records, an estimated percentage of total recreational use on the Forest was identified for each major activity group used in IMPLAN. From this point each alternative had its recreation use broken out by these percentages.

The resulting RVDs in each activity group used the appropriate final demand values and applied them to each individual sector.

The IMPLAN model was also used to trace the effects associated with changes in Federal expenditure levels and payments to counties associated with the alternatives. A first decade budget level for the Forest was established for each alternative as well as a historic budget level for purposes of comparison. Once the total budget level had been identified, the expenditures were divided into salary and nonsalary components. Recent information suggested that 56.3% of the total expenditures of the Forest were spent on salary related items.

A similar procedure was used to determine payment levels for counties. The actual calculation of payments to local governments (payments to counties) was calculated as 25% of most revenues received by the Forest. One-half of the receipts from O&C lands are given to the counties but this only amounts to about 5% of the total payments to counties. The estimates of payments to counties were not adjusted to for any site specific activities on O&C lands.

The local county offices in the three-county area were contacted to determine how much of their budgets included payments from the Forest and based on their total budget what percentage was spent on salaries and nonsalary items. The county road departments receive 75% of the payments to counties and are production and maintenance oriented and spend approximately 72% of their budget on nonsalary items. Local schools received 25% of the payments to counties and being service oriented spend approximately 15% on nonsalary items. Payments from O&C receipts are not spent on any specific county budget items, but again, the payments make up such a small portion of the total payments to counties that no specific changes were made for payments from O&C lands.

For the salary component of Federal expenditures and payments to counties an additional adjustment was made to reflect the fact that the only part of salaries that influences local economies is that portion actually spent or invested locally. Amounts withheld for such deductions as Federal taxes, state taxes, and retirement are not spent locally. In 1982 approximately 33% of the total personal income was subsequently withheld in such a fashion. This percentage was applied to salary expenditures to reduce them to net salaries.

Once these payment levels had been identified and separated by salary and nonsalary components, the IMPLAN model was used to structure the nonsalary expenditures by the Forest to represent typical Federal expenditures. The nonsalary components of payments to counties were also modeled as typical expenditures for local governments.

Salary components from the Forest's budget and those payments to counties were combined and modeled as typical personal consumption expenditures.

Comparison of Alternatives

For purposes of comparing the alternatives, a base historical situation was defined reflecting estimates of the Forest's influence on the three county area for the past decade, 1980 through 1989. Estimates of timber quantity harvested, recreation activity, payments to counties, and expenditures by the Forest Service were made for this period. These were then compared to the results of the alternatives. Table B-26 lists the base historical levels used for these categories and the changes from the base level for each alternative.

SOCIAL AND ECONOMIC IMPACT ANALYSIS

Tables B-27 and B-28 summarize the quantifiable data associated with each alternative on employment and income. Table B-27 identifies the potential change in jobs for each alternative for the four major categories that were tracked. Table B-28 shows the total change in jobs and personal income for each alternative as contributed to by the direct, indirect, and induced change categories. These data all represent potential changes for the first decade relative to average conditions experienced over the 1980-1989 base period. Additional discussion of results can be found in Chapter 4 of the FEIS.

Table B-26. Base Historical Output Levels and Changes¹

			Alternatives						
Outputs	Units	Base	NC	K	A	J	W	D	L
Developed	MRVD	1,723.4	332.6	332.6	332.6	332.6	332.6	332.6	332.6
Semiprimitive Non-motorized	MRVD	59.4	-7.6	-50.7	-9.7	-5.4	-7.6	10.6	-7.3
Semiprimitive Motorized	MRVD	53.3	-3.4	10.7	-4.7	10.7	10.7	10.7	10.7
Roaded Natural	MRVD	1,056.8	-2.7	221.6	221.6	221.6	221.6	221.6	221.6
Roaded Modified	MRVD	311.7	64.8	64.8	64.8	64.8	64.8	64.8	64.8
Pristine	MRVD	14.0	2.7	2.7	2.7	2.7	2.7	2.7	2.7
Primitive	MRVD	110.4	20.7	20.7	20.7	20.7	20.7	20.7	20.7
Semiprimitive	MRVD	116.5	-49.5	-28.1	-28.1	29.3	-10.6	-107.0	33.3
Transition	MRVD	54.6	11.4	11.4	11.4	-30.0	-32.5	-54.6	-31.6
Federal Expenditures ²	MM\$	14.58	13.17	9.04	9.37	5.12	3.97	4.14	-4.60
Salaries									
Federal Expenditures ² Other	MM\$	16.88	15.26	10.47	8.55	5.94	4.60	4.81	-5.33
Payments to Counties ² Salaries	MM\$	6.18	5.58	2.92	2.30	1.32	0.97	0.31	-3.90
Payments to Counties Education	MM\$	0.82	0.74	0.39	0.30	0.18	0.13	0.04	
Payments to Counties Noneducation	MM\$	11.80	10.64	5.56	4.39	2.52	1.85	-0.52	
Timber Volume	MMBF	676	337	123	72	-24	-72	.60	-7.43
								-90	-490

¹ The base level represents an average over the 1980-1989 period.

² In 1982 dollars for use in IMPLAN.

Table B-27. Job Changes from the Base Level by Output

		Alternatives						
Outputs	Base ¹	NC	K	A	J	W	D	L
Recreation Use	4,066	454	687	704	713	669	551	715
Federal Expenditures ²	964	871	597	488	338	262	274	-304
Payments to Counties ²	567	510	267	210	121	88	28	-357
Timber Volume	7,660	3,819	1,394	816	-272	-815	-1,020	-5,553
TOTAL	13,257	5,654	2,945	2,218	900	204	-167	-5,499

¹ The base level represents an average over the 1980-1989 period.

² In 1982 dollars for use in IMPLAN.

Table B-28. Changes in Jobs and Income by Category

		Alternatives						
	Base ¹	NC	K	A	J	W	D	L
Jobs								
Direct	6,931	2,869	1,600	1,246	614	272	77	-2,463
Indirect	2,568	1,182	511	345	31	-126	-196	-1,477
Induced	3,758	1,603	834	627	255	58	-48	-1,559
Total	13,257	5,654	2,945	2,218	900	204	-167	-5,499
Income								
Direct	156.8	72.4	35.7	26.0	8.6	-0.4	-4.8	-75.9
Indirect	93.5	44.9	18.2	11.7	-0.5	-6.6	-9.2	-59.6
Induced	90.0	38.4	20.0	15.0	6.2	1.4	-1.1	-37.3
Total	340.3	155.7	73.9	52.7	14.3	-5.6	-15.1	-172.8

¹ The base level represents an average over the 1977-1985 period.

² In 1977 dollars for use in IMPLAN.

Social Impact Assessment

The following describes the design of a system to analyze the qualitative and quantitative socioeconomic effects of alternatives displayed in the FEIS. Chapter IV shows the estimated effects of each alternative using the Socioeconomic Categories, Socioeconomic Measures, and planning issues tracked through the Socioeconomic Measures. These effects are also summarized in Chapter II.

A socioeconomic overview (SEO) for the Forest was completed in 1983 by a sociologist on the Forest Interdisciplinary Planning Team. The SEO analyzed a number of different social and economic aspects of the counties that surround the Forest. The SEO delineated three counties as being within the Forests primary area of influence: Lane, Linn, and Marion. The SEO also identified eight secondary counties that surround or are influenced by the resources from the Forest: Clatsop and Columbia Counties (anadromous fish), Multnomah (recreation), Yamhill, Benton, Douglas, Deschutes, and Jefferson Counties (recreation and some timber products). The effects estimation did not reference the secondary counties as the data were too difficult to quantify based on the differences between Forest outputs in the alternatives. The SEO went on to categorize several smaller rural communities within the primary counties that are dependent on Forest resources for basic employment and recreation needs: North

SOCIAL AND ECONOMIC IMPACT ANALYSIS

Santiam Canyon (Marion and Linn Counties), Sweet Home and Eastern Linn County, McKenzie River Valley (Lane County), and the Oakridge-Westfir Area (Lane County).

In addition, the SEO identified the major community lifestyles that are tied to employment: agriculture, lumber and wood products, other manufacturing, and nonmanufacturing/service (including government). These employment sectors served as a socioeconomic category indicator for this analysis. This category is strongly related to the changes in jobs that are predicted by alternative. Employment changes most with the level of timber harvest, and somewhat to the recreation opportunities, both on and off the Forest. The largest effect is simply the opportunity for employment and whether the job is a higher income industrial or forestry job as opposed to an entry or lower paying service sector job. This tends to have effects on the total amount of persons moving to or from an area, but it can be offset by family ties, desirability of the area for living/working, unemployment insurance, and prospects for other employment.

There are various government bodies and social organizations within the area of influence. However, the effects of implementing each alternative were only estimated for the county governments (revenues and taxes). Estimates of the effects on city governments, as well as the various social groups, were considered too difficult to estimate and highly variable due to circumstances beyond the control of actions proposed through the FEIS.

There are qualitative judgements about the expected degree of social cohesion/polarization that is likely to occur for each alternative due to different types of management of areas on the Forest. Social cohesion (sometimes referred to as social acceptance/rejection) concerns the allocation of, or management of, scarce natural resources by the Forest. Varying the acres or areas of roadless lands, spotted owl habitat, old-growth, and timber management (including harvest levels) are the major controversial points (polarization) of this socioeconomic indicator, as qualitatively measured through coverage by regional and local newspapers, magazines, TV and radio broadcasts, as well as professional judgement.

Several other social categories were considered, but not in detail, for the Forest alternatives. The first was the potentially affected minority groups within the primary counties, including Black, American Indian, Hispanics, and others. Logical suggests that some indirect effects will occur to the minority groups; however, they are practically impossible to estimate as the alternatives are constructed. Forces external to the planning process, such as changes in EEO or Civil Rights laws or procedures, as well as Immigration and Naturalization Service policies, should have greater effects on minorities than any of the proposed alternatives.

A socioeconomic category was considered for population growth within the area of influence. The individual tendencies for people to move or stay will be little influenced by Forest alternatives. Thus, it is expected that Forest management will have little effect on population growth, especially in Lane County. Population changes in the primary zone of influence may be indirectly affected by employment changes by alternative, but the overall population change still depends on choices of the individual or family. Even when lumber and wood products employment was down during the last decade, workers stayed in their communities, often relying on unemployment insurance, spouse employment, savings, etc. Some changed occupations, while many others waited for the economy to pick up and the mills to reopen.

A socioeconomic category of attitudes, beliefs, and values was considered but also rejected. As these components of the socioeconomic environment are generally reflected in each person rather than a group or society, it is difficult to measure the effect of each alternative on such a category. As with population growth, a person's attitudes, beliefs, and values tend to be influenced more by the person,

family, and social groups and organizations (reference groups) than by changes between alternatives. As a consequence, the Forest could not estimate the differences between alternatives for this category.

Lastly, a potential socioeconomic category, that of land ownership and land use patterns off-Forest by alternative, was also rejected. This category was not considered because the planning group felt that the alternatives would have no effect on this measure. The Forest will coordinate with the concerned counties to make sure that the State Land Conservation and Development Commission (LDCD) zoning of Forest lands remains compatible. Land exchanges will remain at a low level.

For the purpose of estimating the socioeconomic effects of alternatives, the members of the Forest Planning Team identified employment, payments to the counties, lifestyles, and community cohesion as social categories to be used in assessing the effects of the alternatives on communities.

With the socioeconomic categories established above, qualitative socioeconomic measures were identified for estimating effects of the Forest alternatives in the FEIS. The following defines the socioeconomic measures used:

- **EMPLOYMENT DISTRIBUTION** - This item measures job shifts including increases and decreases, changes in the types of jobs - skilled/unskilled, full-time/part-time/seasonal differences, pay differentials - high pay/low pay work, etc.
- **LIFESTYLE** - This item measures the use of the National Forest for such activities as firewood cutting, hiking, camping, cross country skiing, hunting, fishing, off-road vehicle use, visual quality, etc. Negative effects on lifestyles occur when actions reduce employment opportunities, decrease use of the Forest for subsistence and recreation, and lower the environmental quality of the area.
- **COMMUNITY COHESION AND POLARIZATION** - This item measures the degree of unity and cooperation among various segments of a community in realizing mutual goals or solving problems. The degree of acceptance or rejection of Forest management practices, division between the Forest Service personnel and local groups, the agreement or polarization between groups, etc. are variables in the analysis of the effects of Forest actions. The Forest's public issues are one way to track this measure.
- **EXPECTATIONS OF STABILITY OR CHANGE** - This item measures the ability to handle change (resistance or acceptance), rate and amount of expected change, traditional ways of doing things, uncertainty of the future (especially employment), reactions to newcomers, etc. This measure can also be tracked through public issues.
- **JOBS** - This item measures the IMPLAN estimated job losses/gains or shifts within the primary area of influence.
- **INCOME** - This item measures the IMPLAN estimated flow of personal income, or differences in the amount of income, or shifts within the area of influence.
- **REVENUES** - This item measures the estimated federal revenues (generated from FORPLAN) that should be returned to the U.S. Treasury and the county governments from timber receipts and user fees (usually recreation). At the county level, these monies are earmarked for use for schools and roads for 25% fund receipts, but the O&C revenues go to counties to be spent however they wish.

ANALYSIS PRIOR TO THE DEVELOPMENT OF ALTERNATIVES

Introduction

The primary analysis prior to the development of alternatives was the Analysis of the Management Situation (AMS). Other analyses pertinent to development of the FORPLAN model are described in Section C of this Appendix. A comprehensive analysis of resource and economic production capabilities is required in the Analysis of the Management Situation. This was accomplished through FORPLAN computer runs known as benchmarks. The purpose of benchmark analyses was to provide information on:

- The implications of complying with legal policy constraints, including minimum management requirements of 36 CFR 219.27.
- The effects of economic and other modeling assumptions.
- The schedule of management activities, resource outputs, effects, costs and present net value (PNV) associated with a single resource or an economic emphasis of individual benchmarks.
- The potential to resolve issues and concerns.
- The need to change current management direction.
- The range within which integrated alternatives could be developed.

All benchmarks which were developed in this analysis are designed to be approximately implementable and are not constrained by budgets (except for the No Action Benchmark).

A maximum PNV objective function is generally used to obtain a final analytical solution in FORPLAN. The required benchmarks for the Forest are:

- No Action.
- Minimum level.
- Maximum present net value including assigned values.
- Maximum present net value with market values only.
- Maximum resource levels.

Individual resource benchmarks were developed for timber and recreation. Many variations of these economic and resource benchmarks were run to assess the opportunity costs and resource tradeoffs associated with meeting specific objectives, regulations, policies and assumptions. These analyses are discussed in the following sections. For the FEIS both the maximum present net value and the maximum timber benchmarks have been re-calculated. Please review the discussion of these benchmarks to gain an understanding of how FEIS modeling changes have affected the Management Situation.

Development of Management Requirements

Development and Analysis

Management requirements (MRs) assure that a viable level of resources will be provided over the length of the planning horizon. These requirements stem from the National Forest Management Act as interpreted by its implementing regulations (36 CFR 219.27).

Additional direction for developing these requirements was provided the Forest in the form of *Regional Guidelines for Incorporating Minimum Management Requirements in Forest Planning* (1920 2/9/83).

These guidelines established the Regional interpretation of the requirements. The management requirements described in the Regional Guidelines deal with:

- Requirements that are outside the Forest Service's authority to change.
- Requirements which impose substantive standards (as opposed to procedural).
- Requirements that can be dealt with in the analysis.
- Requirements which are likely to have an impact on analysis.

Specific MMRs applicable to the Forest are presented in Table B-29. Of the requirements listed, it was necessary for the Forest to evaluate and select appropriate modeling techniques for the following:

- Old-growth/mature habitat for the spotted owl, pileated woodpecker, and marten.
- Riparian areas.
- Snags.
- Harvest dispersion.
- Soil and water conservation.

For old-growth and mature habitat, Regional planning direction (1920, 11/10/83) states that this assessment can take a variety of forms including "1) Use mapping systems and logic to distribute the species in a way that minimizes the impact on the commercial forest land base, but still achieves the distributional requirements of the species; or 2) Conduct Regional analysis to determine whether set asides or long rotations are least impactful..."

The Forest developed a management requirement spotted owl distribution from an inventory of 219 verified pairs, following the guidelines of the *Final Supplemental EIS for Spotted Owls for Amendment to the Pacific Northwest Regional Guide*, 1989. Pileated woodpecker and marten areas were added to complete the habitat network. While there was little flexibility left given the distributional requirements, logic was applied to minimize impacts to the suitable timber land base while still providing appropriate habitat conditions. Examples of this logic include placement of marten and pileated woodpecker areas in designated Wilderness areas, RNAs and, lands unsuited for timber management.

An analysis of habitat management versus habitat dedication was completed for those areas predominantly occurring on suited lands. Analysis of spotted owl habitat areas on a per acre basis outside of FORPLAN revealed a significant timber falldown under management due to the length of time required for stands to develop old-growth characteristics. This analysis entailed development of a "managed" silvicultural prescription to provide spotted owl habitat, setting the rotation length and habitat area size, and comparing the resultant outputs to dedication of 1,500 acres per spotted owl pair. The procedure followed was to calculate the resultant difference in mean annual increment (MAI) and present net value (PNV) per acre and sum the differences on a Forest-wide basis.

ANALYSIS PRIOR TO THE DEVELOPMENT OF ALTERNATIVE

Table B-29. Management Requirements for the Willamette National Forest

Resource/Requirement	Specifics
Timber Reforestation within 5 years of harvest Nondeclining yield (unless departure requirements are met). Harvest unit size restrictions by ecological zone (40-60 acres). Perpetual timber harvest. Rotations set at 95% CMAI or later. Harvest dispersion standards.	Created opening = 4 1/2 feet tall; maximum harvest rate/decade = 30 %
Wildlife Maintain sustaining habitat for all management indicator species. Provide additional protection for special habitats and sensitive species not selected as management indicators through Forest-wide standards and guidelines.	Primary cavity excavators; 20% of biological potential. Spotted owl; 78,000 acres. Pileated woodpecker; 12,300 acres. Pine marten; 21,120 acres. Bald eagle; 1,080 acres. Fish; see riparian areas. Peregrine falcon; maintain 12 sites. Dead and down woody debris, cliffs, caves, talus, natural openings, and meadows. Sensitive plants, western spotted frog, Townsend's big-eared bat, Oregon chub, and wolverine.
Soil, Water, and Riparian Areas Harvest dispersion constraint for riparian areas. No timber harvest flood plain, wetland, soil and water resource protection areas.	Class I -- 5% harvest rate/decade. Class II -- 5% harvest rate/decade. Class III -- 6.7% harvest rate/decade. Lakes -- 6.7-10% harvest rate/decade. 21.5% of riparian areas.
Miscellaneous Developed recreation sites managed by the Forest Service which receive use in excess of 60% of theoretical capacity, or are located in the Oregon Cascades Recreation Area (OCRA). Stipulated mining claims	17 sites on 341 acres. 128 acres.

Marten and pileated woodpecker areas were evaluated outside of FORPLAN using the same technique. Preliminary results indicated that a managed approach was slightly more efficient from a PNV and timber volume standpoint. This analysis was based on the following criteria:

Species	Approximate Size of Habitat Area	Timber Type	Rotation Length
Marten	450 Acres	Douglas-fir/Western hemlock	150
		Douglas-fir/True fir	170
		True fir	180
		Mountain hemlock	200
Pileated Woodpecker	1,000 Acres	Douglas-fir/Western hemlock	140
		Douglas-fir/True fir	150
		True fir	170

Additional analysis in FORPLAN indicated that the difference in PNV and first decade Allowable Sale Quantity (ASQ) between the managed and dedicated approach for marten and pileated woodpecker were insignificant on a Forest-wide basis (less than 0.1% difference). Thus, the Forest selected a dedicated approach for spotted owl, marten, and pileated woodpecker habitat in the DEIS and based on public comment used both approaches for marten and pileated woodpecker in the FEIS.

MRs for riparian areas, and for soil and water are linked together: practices affecting soil and water in the upland areas affect riparian areas, and practices in riparian areas affect soil and water conditions. Several alternative methods of meeting these requirements were considered including selection of a riparian indicator species. Two of the more direct methods involved dedicating riparian areas to nontimber harvest prescriptions and placing rate of cut constraints on watersheds. These two methods would most directly ensure meeting MRs but would also have the greatest impact on timber harvest and, therefore, the most effect on PNV. The IDT thus sought to find alternative standards and guidelines that would meet requirements but have less impact on PNV. The selected approach relies on a mix of practices and project level standards and guidelines, as well as full protection restrictions on potentially unstable streambanks, and rate of harvest constraints within Class I, II, III, and lake riparian areas. This combination requires the minimum trade-offs necessary to ensure meeting riparian requirements.

Harvest dispersion constraints are also explicitly portrayed in the Willamette FORPLAN model. Following the two-step process outlined in the Regional planning direction (1920 11/10/83), a theoretical dispersion factor was calculated. This factor was modified after intensive mapping exercises demonstrated that slightly higher percentages could be harvested and still meet dispersion requirements. The application of the dispersion factor was adjusted to fit the modeling changes that occurred for the FEIS.

MRs for the provision of snags outside of areas dedicated to old growth management require snags at least 18 inches in diameter for some primary cavity excavators (Forest Planning process paper: Dead and Defective Tree Habitat). DEIS benchmark analysis showed that 12 inch trees could be provided through normal mortality without additional constraints or allocations to meet this requirement. For the FEIS each harvest unit is required to maintain the 18 inch snags over time, with up to 2% change in the harvestable volume on every acre.

ANALYSIS PRIOR TO THE DEVELOPMENT OF ALTERNATIVE

The evaluation outlined above resulted in the selection of techniques which best satisfied on-the-ground management and economic efficiency criteria. The selected methods have been incorporated into the Forest FORPLAN model. Appendix H of the DEIS describes the development of MRs in more detail.

Impacts and Effects

Several FORPLAN runs were made with different MR constraints present so that the effects of MRs could be determined. All of these runs used the maximum PNV benchmark as a base against which to make comparisons. This run maximized PNV subject to all MRs. The runs used for comparison differ from this run only in the absence of constraints designed to meet one or more MR. Table B-30 shows the results of these runs. Appendix H of the Draft EIS describes the impacts of MRs in more detail.

Table B-30. Management Requirements - Effects on PNV and Timber Harvest

	LTSY ¹		1st Decade ASQ ¹		PNV ¹		
Description	MMCF	Percent Change	MMCF	Percent Change	\$MM	Percent Change	Comments
Maximum PNV W/ all MRs	120.2	--	117.3	--	\$3,782	--	This benchmark is the basis for comparison.
Dispersion MR	120.4	(+0.2)	119.0	(1.4)	\$3,994	(5.6)	Not modeling dispersion allows harvest rates to exceed 25%-30% of a watershed per decade.
Mature Timber	123.0	(+2.3)	120.5	(2.7)	\$3,908	(3.3)	Not modeling this MR adds 18,880 acres to timber production.
Riparian MR	124.0	(+3.2)	121.7	(1.2)	\$3,901	(3.1)	Removing this MR adds 11,123 no harvest and 42,742 reduced harvest acres into full yield timber harvest.
Spotted Owl	130.2	(+8.3)	128.2	(9.3)	\$4,237	(12.0)	Not modeling this MR adds 70,339 acres to timber production.
TOTAL		(14.0)		(14.6)		(24.0)	
Maximum PNV without MRs ²	132.5	(N/A)	129.6	(N/A)	\$6,073	(N/A)	This data is included as a reference to the DEIS. The percent change information is not valid because many coefficients have changed between the DEIS and FEIS.

¹ These effects are maximum estimates based on benchmarks. Actual opportunity costs are less when MRs are needed in part or totally to meet a resource objective in one or more of the alternatives.

² The maximum PNV without MRs benchmark was not re-calculated using FORPLAN. The information used here is from the DEIS.

As you look at Table B-30 you will note that the effects of managing for the Spotted Owl under SEIS guidelines is as much or more than all of the other MRs put together. For each of the MRs the effect on PNV is generally a function of Douglas fir old growth harvests and the effect on timber is a function of Douglas fir small sawlog or medium sawlog harvest. Also the reader may note that the total timber difference (maximum PNV without any MRs) does not equal the sum of the MR effects. This discrepancy is due to the overlapping nature of the requirements (i.e. riparian areas that exist within spotted owl habitat areas). The reader should not attempt to compare PNVs for the maximum PNV without MRs and the maximum PNV with MRs. The maximum PNV without MRs data was generated using DEIS data and assumptions while the maximum PNV with MRs used updated FEIS data.

Benchmark Formulations

The role of benchmark analysis in the AMS is specified in 36 CFR 219.12(e). Benchmark analysis serves a variety of purposes, including:

- Defining the range within which alternatives can be constructed.
- Defining the maximum economic and biological resource production potentials.
- Estimating the mix of resource uses, as well as a schedule of outputs and costs, associated with the objectives of each benchmark.
- Analyzing the potential to resolve issues and concerns.
- Analyzing the implications of continuing current management direction and whether a need to change current direction exists.
- Analyzing the implications of existing laws and policies.
- Analyzing the implications of economic assumptions.
- Evaluating the complimentary and conflicting production relationships between the goods and services provided by the Forest.

For the FEIS, the No Action (Alternative A), maximum PNV and maximum timber Benchmarks have been re-calculated. These results are displayed side-by-side with the DEIS benchmarks to help the reader understand the effects of the numerous changes in data and assumptions that are used in the FEIS. The analysis was documented in the *Transition Analysis* (Scanlon, 1989) and the *MR Results* (Scanlon, 1989) which can be found in the planning records at the Forest Supervisor's Office. A discussion of the purpose and objectives for each benchmark follows Tables B-31 and B-32 which contain the allocation and output summaries for the benchmarks. Unless stated otherwise, each benchmark that harvests timber will meet the following requirements:

- Timber harvest is scheduled only on lands classified as "available and suitable" for timber management.
- Timber harvest cannot decrease in any decade as compared to the immediately preceding decade (NDY).
- Timber harvest cannot exceed the long-term sustained yield capacity in any decade.
- Regeneration cuts cannot be scheduled until stands have reached 95% CMAI
- An objective function of "maximize PNV" is used. Both market values and assigned values are included in the calculation of PNV.
- MRs are met or exceeded.

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- Sufficient timber inventory must remain at the end of the modeling horizon to sustain timber harvests that occur at the end of the modeling horizon.
- Developed recreation sites which currently exceed 60 % of their theoretical capacity are not available for timber management.

Minimum Level

The minimum level benchmark determines the costs necessary to retain National Forest Lands in federal ownership. Minimum environmental constraints and protection of the life, health, and safety of users must be provided.

The purpose of developing the minimum level benchmark is:

- To determine the minimum costs involved with maintaining National Forest lands in the National Forest system; i.e., a cost level that is not discretionary in the Programming and Budgeting process within the direction provided.
- To determine the pertinent outputs and effects related to this "minimum expenditure" level.

Those assumptions and constraints necessary to the benchmark formulation with significant bearing on costs, outputs, and effects estimation are listed below:

- Practices and costs are only those necessary to keep the Forest in public ownership under the assumptions noted below.
- Some costs are necessary including those to protect the life, health, and safety of incidental users; to prevent environmental damage to lands or resources of adjoining ownerships; and to administer unavoidable special uses.
- Significant impairment of the productivity of the land is not allowed.
- Outputs associated with this benchmark include only significant and uncontrollable outputs and uses such as water yield, sediment, wildlife, fisheries, and incidental recreation use.
- A "no harvest" prescription is applied to all analysis areas; timber sales have been completed or terminated.
- Costs for a transition "close down," necessary if this benchmark were to be implemented, were not included as per Regional direction.
- Developed recreation sites and special uses would be closed or terminated.
- Trail system would be reduced by eliminating those trails maintained at Levels 1 and 5. National trails would be maintained at Level 2 with all remaining trails not eliminated at Level 1.

- Grazing would be discontinued.
- Unavoidable non-Forest Service special uses and developments related to private mineral rights would be allowed.
- The road system would be reduced and maintained at a minimum safety level.
- Fire, administrative, and other facilities would be maintained at the needed level.
- Fish and wildlife habitat improvements necessary to prevent adverse impacts to threatened and endangered species and to prevent conditions from developing which would create a nonviable situation for existing native species.

Table B-31. Benchmark Allocation Acres

Management Strategy	Min Level	No Action		Max PNV		Max Timber		Max Recreation
		DEIS	FEIS	DEIS	FEIS	DEIS	FEIS	
General Forest (GF) ¹	0	1,019,162	874,271	1,262,821	918,807	1,264,677	927,942	0
No Harvest (GF) ¹	0	0	164,137	0	343,225	0	334,090	0
Dispersed Recreation	6,122	96,258	85,277	6,122	6,122	6,122	6,122	284,222
Wild and Scenic Rivers	0	0	14,462	0	0	0	0	5,035
Scenic Resource (Visuals)	0	146,792	118,723	0	0	0	0	960,830
Old-Growth Groves	0	2,721	2,730	0	0	0	0	2,264
Wilderness ²	380,890	380,890	386,863	380,890	380,890	380,890	380,890	386,906
Special Interest Areas	1,813	1,813	1,109	0	0	0	0	6,570
Research Natural Areas	2,197	4,245	2,197	2,197	2,197	2,197	2,197	2,197
Experimental Forest	15,379	15,379	15,379	15,379	15,379	15,379	15,379	15,379
Developed Recreation	0	3,754	4,330	3,605	4,330	1,749	4,330	3,754
Land Uses	0	4,479	4,543	4,479	4,543	4,479	4,543	4,479
Special Wildlife Habitat	0	0	1,472	0	0	0	0	4,521

¹ Includes all acres not available (including roads, MRs, nonforest, unsuited).

² Includes Oregon Cascades Recreation Area (OCRA) - 6,122 acres.

No Action

This benchmark provides for management of the Forest using the current Forest Plan, as adjusted to incorporate changes since 1977, including MRs for various resources. Some of these changes have occurred since the DEIS was written. Data from the DEIS is displayed along with the FEIS No Action Alternative so that the reader can review the effects of changes that have occurred since the DEIS. These changes are listed in the *Introduction* to Appendix B and briefly listed in the *Introduction* to Chapter II.

This benchmark provides for a wide range of multiple uses through the allocation of land for developed and dispersed recreation, scenic quality, special interest areas, education and research, fish and wildlife, water, wilderness, and wood products. Forest management under the current plan continues to emphasize scenic quality in major Forest viewsheds, dispersed recreation primarily at higher elevations, and timber harvest from the Forest's most productive lands.

This benchmark estimates the capability of the planning area to provide a wide range of goods, services, and uses from present land allocations, and the consequent costs, benefits, and outputs, through the application of management prescriptions.

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Pertinent assumptions and constraints in addition to those listed for all benchmarks include:

- Management allocations from the 1977 Willamette National Forest Land Management Plan are assigned the appropriate prescription.
- Harvest accessibility will be deferred in areas where existing conditions are inconsistent with prescription standards.
- Current budgetary levels are used.

Table B-32. Outputs, Effects, Activities, and Costs for the Benchmarks

Output, Effect, Activity or Cost	Units	Min Level	No Action		Max PNV (Assigned)		Max Timber		Max Recreation
		DEIS	DEIS	FEIS	DEIS	FEIS	DEIS	FEIS	DEIS
Developed Recreation Use	MRVDs	0	1,625	2,056	1,774	2,056	1,002	2,056	1,877
Nonwilderness Dispersed Recreation Use									
Semiprimitive Nonmotorized Use	MRVDs	88	28	50	1	0	1	0	58
Semiprimitive Motorized Use	MRVDs	70	39	49	7	13	7	13	62
Roaded Natural Use	MRVDs	147	300	1,278	1	0	1	0	686
Roaded Modified Use	MRVDs	254	442	376	753	2,142	755	2,142	340
Wilderness Recreation Use	MRVDs	126	267	352	255	369	255	369	246
Visual Quality Objectives									
Preservation	M Acres	774	449	547	389	389	389	389	686
Retention	M Acres	308	85	78	0	0	0	0	402
Partial Retention	M Acres	222	101	150	4	4	2	2	4
Modification	M Acres	402	0	5	0	0	0	0	565
Maximum Modification	M Acres	0	1,035	895	1,283	1,283	1,285	1,285	15
Spotted Owl Habitat Areas	Number	152	87	59	78	59	78	59	78
Pileated Woodpeckers (Unique Sites)	Number	41	128	156	41	156	41	156	41
Pine Marten (Unique Sites)	Number	132	347	256	132	256	132	256	132
Big-Game Use	MWFUDs	32	41	NE ²	71	NE ²	71	NE ²	44
Other Wildlife Use	MWFUDs	27	38	NE ²	64	NE ²	64	NE ²	71
Anadromous Fish Use	MWFUDs	61	87	NE ²	108	NE ²	109	NE ²	140
Resident Fish Use	MWFUDs	54	93	NE ²	111	NE ²	111	NE ²	119
Allowable Sale Quantity	MMBF	0	611	748	660	667	663	654	102
Allowable Sale Quantity	MMCF	0	107	135	113	117	117	118	18
Fuelwood	M Cords	0	54	54	60	59	61	59	10
Reforestation	M Acres	0	11.3	12.1	11.9	13.1	13.9	13.2	2.1
Timber Stand Improvement	M Acres	0	5.2	20.7	4.1	NE	4.2	NE	2.6
Long-Term Sustained Yield	MMCF	0	116.7	113.5	123.1	120.2	123.3	126.4	88.3
Total Budget	Million \$	3.7	46.5	58.2	40.7	60.9	40.4	63.4	9.5
Returns to Government	Million \$	0	120.9	119.9	130.0	146.4	131.0	134.6	20.2
Payments to Counties	Million \$	0	30.2	30.0	32.6	36.6	32.7	33.6	5.1
Changes in Jobs	Number	NE	1,412	2,219	1,072	NE	1,110	NE	-4,234
Changes in Income	Million \$	NE	34.7	52.7	32.4	NE	33.2	NE	-94.1
Area Available for Specific Resource Uses									
Timber Harvest	M Acres	0	906	NE	937	NE	937	NE	759
Mineral Exploration	M Acres	1,236	1,128	NE	1,228	NE	1,229	NE	1,222
Present Net Value	Billion \$	0.86	4.55	3.18	4.58	3.78	4.87	3.48	2.72
Discounted Benefits	Billion \$	1.13	8.33	6.36	8.26	7.15	8.82	7.07	4.63
Discounted Costs	Billion \$	0.27	3.78	3.18	3.68	3.36	3.95	3.60	1.91

¹ NE = Not Estimated

Maximum Present Net Value

The purpose of these benchmarks is to estimate the mix of resource uses, combined with a schedule of outputs and costs, which maximizes the present net value of Forest outputs. The maximum Present Net Value (PNV) benchmark can be calculated on just those commodities which are traded in established markets (i.e. timber, range forage, commercial fish, developed recreation, and minerals) or on *market values plus assigned values*. Assigned values are values which are estimated for outputs which do not have established market prices (i.e. dispersed recreation, wilderness recreation, fish and wildlife, and water use).

Market and Nonmarket Output Relationships - Prior to formulation of the benchmarks for the AMS, an analysis was conducted to see if nontimber prescriptions could compete with timber prescriptions in terms of PNV when recreation values were considered. A preliminary analysis of nontimber prescriptions was conducted outside of FORPLAN to determine if they could compete with timber on a per acre basis. Dispersed recreation and scenic resource prescriptions were analyzed and compared to timber prescriptions. This analysis showed that when an existing stand could not be harvested immediately, the higher recreation values enabled a number of these nontimber prescriptions to be economically competitive. To determine if this would still hold true on a Forest-wide basis when future stand growth considerations enter into the analysis, a FORPLAN run was made which included the most competitive of the nontimber prescriptions. Approximately 920 acres went to a scenic prescription in this run. The rest of the land base all went to timber harvest prescriptions (approximately 950,000 acres).

The main reason nontimber prescriptions cannot compete with timber harvest prescriptions is that producing additional recreational benefits involves a reduction in the harvest rate of existing high valued timber stands. Additional costs are also a handicap for the nontimber prescriptions. Since less than 0.1 percent of the suitable timber acres went to nontimber prescriptions in the analysis, nontimber prescriptions were dropped from further consideration when PNV was the sole objective. The only difference between the benchmarks for maximum PNV with market values only and maximum PNV with market values and assigned values is that the assigned values are included in the calculation of discounted benefits and present net value with the assigned value benchmark, but not the market value only benchmark.

The FEIS comparison displayed in Table B-32 shows the sensitivity of Forest-wide solutions to changes in the values and assumptions between the DEIS and FEIS. Only those assumptions and constraints listed for all benchmarks are pertinent to the PNV benchmarks.

Maximum Timber

This benchmark estimates the highest sustainable level of timber volume that can be harvested on the Forest, subject to the MRs of the other resources.

The objective function for this analysis was to maximize volume in the first decade. Comparisons of this benchmark to the other benchmarks show the effect on timber production of meeting other resource and economic objectives.

In addition to those assumptions and constraints listed for all benchmarks, this benchmark will:

ASSUMPTION AND POLICY ANALYSIS

- Defer harvest accessibility in areas where existing conditions are inconsistent with prescription standards.
- Vary management intensities according to accessibility for commercial thinning and fertilizer response.

Maximum Recreation

This DEIS benchmark provides for high quality recreation opportunities in both developed and undeveloped settings, and a balance between off-road motorized use and nonmotorized activities consistent with resource protection and land capability. The benchmark emphasizes scenic quality in the viewsheds of State and federal highways, Forest roads, and along all Forest trails.

This benchmark also provides for specialized recreational opportunities in areas of botanic, scenic, geologic, or historic significance as well as some special wildlife habitats. Wilderness opportunities will increase slightly, and the upper McKenzie River would be a Recreation River.

The purpose of this benchmark is to illustrate the Forest's capacity to provide a wide variety of recreation opportunities and determine consequent costs, benefits, and outputs for all resources.

This benchmark estimates the maximum capability of the planning area to provide opportunities for wilderness recreation, nonwilderness dispersed recreation, developed recreation, special feature or habitat related recreation, and wild and scenic river recreation.

Only those assumptions and constraints listed for all benchmarks are pertinent to this benchmark.

ASSUMPTION AND POLICY ANALYSIS

Timber Harvest Policy Analysis

In response to National and Regional direction (1920 8/8/83 and 1920 11/10/83), a series of FORPLAN runs was made to determine the effects of timber harvest policies. The two types of constraints examined were nondeclining yield (NDY), and rotations restricted to 95% CMAI. The effects of these policies were examined independently and in combination. All runs included MRs and were made using a maximum PNV objective function with assigned values.

Runs without NDY as a constraint allowed volumes to vary as much as 25% between successive decades and contained a floor of 86 MMCF (80% of 5 year sell). Runs without CMAI as a constraint could harvest when stands reached the minimum utilization standard of 7 inch d.b.h. Table B-33 shows the results of the sensitivity tests.

Table B-33. Effects of Harvest Scheduling Policy Requirements

Constraints	LTSY (MMCF/Yr)	Change in LTSY (%)	1st Decade PNV (MMCF/Yr)	Change in ASQ (%)	PNV (MM\$)	Change in PNV (%)
CMAI + NDY	122.8	--	109.7	--	\$4,460	--
W/O CMAI, W/NDY	119.0	- 3.1	113.0	+ 3.0	4,479	+0.43
W/CMAI, W/O NDY	122.4	- 0.3	117.0	+ 6.7	4,568	+ 2.41
W/O CMAI, W/O NDY	122.2	- 0.5	117.5	+ 7.1	4,569	+ 2.44

The effects of constraining rotations to 95% of CMAI are relatively small when compared to those of the nondeclining yield constraint. Changes in present net values generally are related to changes in early decade harvest. The effects of these policies on PNV are summarized as follows:

- Releasing the 95% CMAI constraint results in a 0.43% increase in PNV under a nondeclining yield constraint, and a 0.02% increase without it.
- Releasing the nondeclining yield constraint results in a 2.41% increase in PNV with the 95% CMAI constraint, and 2.0% without it.
- Releasing both constraints simultaneously results in a 2.43% increase in PNV.

The effects of the scheduling policies on the timber resource are summarized as follows:

- Land allocations are not affected by harvest scheduling policies. All acres available for allocation are assigned a timber management prescription regardless of the harvest scheduling requirements used.
- Without the CMAI constraint, first decade harvest increases by 3% with NDY, and by 0.43% without NDY. Conversely, LTSY shows a 3% decrease with NDY, and a 0.16% decrease without NDY.
- Without the NDY constraint, first decade harvest increases by 6.7% with CMAI, and by 4% without CMAI. LTSY shows a slight drop (-0.33%) with CMAI, and a 2.7% increase with CMAI.
- Dropping both CMAI and NDY results in a first decade harvest increase of 7.1%, and a slight decrease of 0.49% for LTSY.

Economic Assumptions

Regional direction for use of price trends requires the use of a 1% increase per year for the first fifty years for the timber value. Other values do not change over time. Regional direction also required sensitivity analysis to examine the effect on the timber volumes scheduled with alternative price trend assumptions of 0% and 3%. The Forest also examined the effects on timber volumes scheduled with a 30% decrease in the base timber value, both with a 0% price trend and a 1% price trend. A final economic analysis tested the effect on timber volumes scheduled with a 20% decrease in timber related costs using a 1% timber price trend. All these analyses were performed with the maximum PNV Benchmark with MRs. Table B-34 contains the results of these analyses. No results differ by more than 0.5% from the result occurring with the assumptions used in the benchmarks and alternatives. Within the range of values and costs tested, the solution from the Forest's FORPLAN model is insensitive to the economic assumptions.

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Table B-34. Results of Economic Assumptions Analyses

Economic Assumptions			Effect on Timber Volume (MMCF)		
Percent Base Value	Percent Price Trend	Percent Cost	1st Decade Annual ASQ	15 Decade Volume Total	LTSY
100	1	100%	113.1	17,265	123.1
100	0	100%	113.4	17,301	123.1
100	3	100%	112.5	17,285	122.5
70	0	100%	112.8	17,212	123.4
70	1	100%	112.6	17,223	123.4
100	1	80%	113.4	17,309	122.9

FORMULATION OF ALTERNATIVES

Introduction

Definition

A Forest Plan alternative is a mix of management prescriptions applied in specific amounts and locations of the Forest to achieve desired management goals and objectives. Each alternative within the range of alternatives was developed to meet the following National Forest Management Act (NFMA) (36 CFR 219.12(f)) requirements:

- Be distributed between the maximum and minimum resource potentials of the Forest.
- Be formulated to facilitate analysis of opportunity costs, resource use, and environmental tradeoffs among alternatives.
- Be formulated to facilitate evaluation of present net value (PNV), benefits, and costs of achieving various outputs and nonpriced benefits.
- Address and respond differently to major public issues, management concerns, and resource opportunities.
- Represent the most cost-efficient combination of management prescriptions to meet the objectives of the alternative.
- State the condition and uses that will result from long-term implementation.
- State what goods and services will be produced, including timing and flow of outputs, and the costs and benefits generated.
- State the resource management standards and guidelines.
- State the purposes of the proposed management direction.

The regulations also require that alternative development processes follow the National Environmental Policy Act (NEPA) procedures contained in 40 CFR 1502.14.

Required Alternatives

The following alternatives are required by National or Regional direction:

- **No Action:** This is the alternative of "No-Action" required by the Council on Environmental Quality (CEQ) regulations (40 CFR 1502.14). This alternative would continue the management of the Forest as defined by existing direction in approved management plans; continuation of existing policies, standards, and guidelines; current budgets updated for changing costs over time; and, to the extent possible, production of current levels and mixes of resource outputs consistent with meeting resource management requirements (MRs).

Alternative A is the No Action Alternative in this FEIS.

- **No Change:** The "No Change" Alternative was developed in response to decisions made regarding appeal number 1588, brought by the Northwest Forest Resource Council on May 19, 1986. The appeal centered on a decision by Regional Forester James F. Torrence to "require inclusion of management requirements (MRs) in the No Action Alternative for each Forest Plan." The substance of the appeal was that a "true no-action alternative representing current management plans" was not included in Forest Plan EIS's. In response to this, a No Change Alternative has been developed to represent the potential yield of the existing timber management plan, and consequently does not comply with all provisions of the NFMA and regulations promulgated by the Secretary of Agriculture to implement NFMA.

Alternative NC is the No Change Alternative.

- **Emphasis on the current RPA program:** This alternative determines how the Current (1980) RPA Program distributed to the Forests through the Regional Guide can best be implemented. Due to public comments, failure to address other key issues, and overall adverse environmental effects, an alternative designed specifically to meet the RPA timber targets is not considered in detail in the FEIS.

Alternative B-Departure is the RPA program alternative in the DEIS.

- **Emphasis on Nonmarket Opportunities:** This alternative places emphasis on the production of wildlife, recreation, and other amenity values. Market oriented resources will be managed at economically and environmentally feasible levels consistent with nonmarket opportunities.

Alternative L is the alternative which emphasizes nonmarket opportunities in this FEIS.

- **Emphasis on Market Opportunities:** This alternative places emphasis on the production of timber and other market commodities. Management for other resources will be at economically and environmentally feasible levels consistent with the emphasis on market oriented outputs.

Alternative K is the alternative which emphasizes market opportunities in this FEIS.

- **Emphasis on Nondevelopment of Roadless Areas and Intensified Management:** This alternative retains all current roadless areas on the Forest in an unroaded condition while managing intensively for commodity production on those areas already roaded.

The analysis for this alternative was performed, but it was not considered in detail as a final alternative.

Alternative Development and Analysis

The following sections describe how the overall themes and resource issues were developed into a range of alternative land allocations and management direction responsive to NFMA, NEPA, and the public.

Information on the amount, condition, and location of resources has been compiled through inventories of timber conditions, recreation use, wildlife populations, soil and water resources, and roads. These inventories were combined in the Geographical Mapping System (GMS) for use in the development and analysis of alternatives.

Alternative Development

The alternative formulation process began in November 1984 with a review of Forest issues, concerns, opportunities and resource inventories; resource production capabilities identified in the analysis of the management situation; and applicable planning direction. Based on a review of these items resource management options were developed for nine resource areas: Recreation; Fish and Wildlife; Timber; Range; Soil, Water, and Air; Minerals and Energy; Lands; Facilities; and Protection. Each option was comprised of management direction statements for the important factors for that resource. The resource management options were designed to incorporate issues, reflect a particular level of management emphasis, and serve as a potential building block for Forest management alternatives.

The draft resource management options were reviewed by the public during 1985, with disclosure that the resource management options would be used as building blocks for alternatives. The public response was evaluated and some resource options were modified to address the public comments. The resulting options were used as building blocks in the development of preliminary alternatives.

A review of the options for the nine resource areas indicated that achievement of the objectives for some resources primarily depend upon the allocation of land and scheduling of timber harvests (Timber, Recreation, and Fish and Wildlife), while other resources are primarily dependent on program budget and/or administrative action.

Since Timber, Recreation, and Fish and Wildlife each depend on the allocation of land areas, to some degree each is in competition with the other. The options for these resources were, therefore, compared to each other to determine their compatibility. Compatibility was judged by the Interdisciplinary Team (IDT) based on the team's knowledge and experience.

The 6 Recreation options, and 7 Fish and Wildlife options were compared with each other and were compatible through all 42 possible combinations. These 42 options were then compared to the 7 timber management options. Depending on the extent to which Recreation and Fish and Wildlife were emphasized, the timber options were compatible at some levels of production. This comparison resulted in 294 possible combinations but only 106 combinations of these three resources were compatible in an integrated alternative.

Since the range of management options for the resources included output levels close to the minimum and maximum benchmark levels, the preliminary alternatives formulated were by design within the range of benchmark levels, and spread throughout the entire range. Benchmarks are discussed in additional detail in Chapter II, *Development and Use of Benchmarks*.

From these 106 conceivable alternatives, seven preliminary alternatives were identified, based on the following objectives:

- Minimizing the number of alternatives in the array that would still include all of the resource management options,
- Minimizing the duplication of resource options in the array, and
- Maximizing diversity in the mix of resource option combinations.

The resource options for Range, Lands, Minerals and Energy, Facilities, Protection, and Soil, Water, and Air were then compared to the seven preliminary alternatives to determine their compatibility. Most of the options for these six resource areas were found to be compatible with the preliminary alternatives. Options for these resources were then incorporated into each preliminary alternative at a level consistent with the general emphasis of each alternative.

From the combinations of resource option descriptions, seven preliminary alternative descriptions were written and rough estimates of some outputs were made. These alternatives were examined as to how well they resolved major facets of the Forest issues. In doing this the following factors were considered:

- Does the range of alternatives provide an appropriate magnitude of response to the issue?
- What other alternatives should there be?
- Are there inconsistent or incompatible items in the descriptions of the alternatives?

Two alternatives were required by NFMA regulations. These were: No Action, and one demonstrating ability to meet the goals of the Resource Planning Act (RPA), were added to the list for consideration at this time. Two additional variations on preliminary alternatives were developed which allowed for departure from long-term sustained yield as a feature. Due to significant overlap and duplication, three preliminary alternatives were dropped leaving 8 alternatives in the DEIS. In June of 1987 a ninth alternative was included in the array of alternatives in response to decisions made regarding an appeal brought by the Northwest Forest Resources Council. The ninth alternative is referred to as the "No Change" (NC) Alternative and is based on the potential yield of the Forest's 1977 Timber Management Plan.

Many comments, recieved during the review period for the DEIS, expressed the publics reaction to how well the key issues were addressed by the alternatives described above. A large number of the commentors expressed the opinion that not all reasonable and viable means of addressing the issues were considered (or at least considered in sufficient detail) in the DEIS. With the aid of these comments, the Forest IDT and management team revisited the alternative formulation process. The resource options or the management prescriptions and the acre allocations were reviewed and revised. The result of the revisions were 3 additional alternatives in the FEIS that were not considered in the DEIS.

While developing these additional alternatives, the Forest staff and IDT contacted several groups and individuals who had expressed specific concerns that alternatives were not adequately considered in the DEIS. These groups clarified their concerns and helped the IDT develop and analyze alternatives that addressed the concerns. Alternative K and Alternative L were developed in this manner. In addition, planning newsletters were sent to all commentors updating them on the development of Alternatives K, L, and W.

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Management Area Development and Management Prescriptions

The identification of land areas which contribute to the goals and objectives of each alternative was an integral part of alternative development. Working from the management options developed earlier, areas of the Forest were identified as particular management areas and assigned a corresponding management strategy.

Management areas are portions of the Forest managed for the same goals and objectives. They are physical units usually delineated on maps, and can be located on the ground. Examples include areas managed to provide specific types of wildlife habitat, particular levels of scenic quality, or intensive timber management. Management strategies (also called management prescriptions) are the direction for activities within management areas, and are detailed in the standards and guidelines that direct on the ground activities, including rates of timber harvest. A total of 38 management areas and strategies were developed for use in the formulation of benchmarks and alternatives. These combinations of resource objectives were available for assignment to specific locations on the Forest as necessary to meet the following criteria:

- Cost efficiency;
- Resource tradeoffs;
- Resource quality and suitability;
- Planning direction;
- Issue resolution.

Cost efficiency, which is a requirement of the NFMA regulations (36 CFR 219.12(f)(8)), is defined as when outputs with assigned dollar values are produced in a way that maximizes net economic value (i.e., benefits minus costs), or are achieved at specified levels in the least costly manner. For the most part analyses on the Forest consistently show this criterion to be met with the highest level of timber production feasible. Therefore, to the extent that timber management was consistent with the other alternative objectives, management strategies were assigned to minimize the impact on the suitable timber land base. Other factors influencing the cost efficiency of an alternative include accessibility, slope, and soil types. These conditions also contributed to management strategy assignment.

In some cases resource tradeoffs were a factor in addition to the economic tradeoffs. Resource quality and suitability were related to the resource tradeoffs considered. For example, attributes such as the size of a roadless area or the opportunity for solitude in a roadless area could influence the assignment of a roadless management area.

Planning direction influenced management area assignment in some cases, particularly in the No Action and No Change Alternatives. Requirements for the No Action and No Change Alternatives mandated use of the land allocations in the current Forest Plan (1977) as a guide for management area assignment. Other direction, such as distribution criteria for spotted owl habitat areas, also influenced management area assignment.

The last criterion, issue resolution, had a direct influence on management area assignment in most alternatives. For example, the roadless area issue varies in intensity according to the particular area under consideration. Similarly, scenic corridors along roads are desired to a greater or lesser degree depending upon the amount and type of use along the road.

Data was then assembled and the management area boundaries used for the alternatives were selected. This process combined analysis and judgment to reflect the optimum assignment of management areas and strategies to meet the goals and objectives of the alternatives developed in the DEIS.

Between the DEIS and the FEIS several of the management areas used to develop the alternatives were also modified. The changes in the management area designations were applied to the alternatives developed since the DEIS (Alternatives K, L, and W) as well as to the alternatives brought forward from the DEIS (Alternatives NC, A, J, and D). In general, these changes did not significantly affect the management strategies of the management areas as described in the DEIS nor the outputs or effects associated with them. For more detail on these changes refer to Chapter II, Management Area Prescriptions and Management Areas.

The next major phase of alternative development involved selection of silvicultural prescriptions to meet alternative objectives across the Forest and through time. Silvicultural prescriptions represent the potential sets of timber management activities that can be implemented on timber stands of different conditions, including precommercial thinning, fertilizing, commercial thinning and regeneration harvesting. Silvicultural prescriptions are selected in the FORPLAN model, which seeks to schedule activities in a cost-efficient manner. A total of 4-8 silvicultural prescriptions were available for selection for each management area, depending upon stand condition. The extent to which FORPLAN selects timber harvest prescriptions determines the timber outputs for each alternative.

Iterative Analysis Process

The analysis process began with a series of FORPLAN runs for model calibration. During this period interaction between constraints was analyzed closely with the intent of resolving district concerns and achieving the intended objectives of the constraints. Because of the complexity of combining water quality objectives and dispersion constraints, the Alternative W model was used to calibrate the constraints to match the objectives.

Upon completion of model calibration, the analysis of individual alternatives began. Each alternative analyzed had unique harvest allocations which are discussed later in the section under *Variations from the Standard Model*. To account for those land allocations with reduced harvest rates and to simplify FORPLAN input, a program called VISPLAN was utilized. The VISPLAN program calculates potential timber outputs from areas allocated to reduced harvest prescriptions. Data from VISPLAN was then used to generate yield tables and absolute constraints that accurately model these allocations.

Each model was then solved using an objective function to maximize timber volume for the first decade.

Description of Standard Model Shell

A standard FORPLAN model shell was developed to ease the task of developing the individual models used to analyze alternatives. A description of this basic model is found in Appendix B, The Forest Planning Model. The shell model has a standard set of identifiers, qualifiers, treatment types, activities, outputs, cost data, objective function, and much of the yield data. A standard set of prescriptions also exists for all alternatives except Alternative L which has additional prescriptions of lower harvest. In order to customize the shell model into an alternative model, the analysis areas and constraints unique to the alternative are added to the shell data deck.

Description of Common Constraints

Introduction

Constraints are one tool by which the model can be manipulated in order to provide an accurate mathematical representation of the alternative. Several sets of constraints were applied to the standard

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model shell during the analysis of alternatives. These common constraints fall into four categories: 1) constraints which assign congressionally and administratively designated areas to specific prescriptions, 2) constraints which ensure that the Management Requirements (MRs) are met in each alternative, 3) timber scheduling constraints, and 4) operational constraints which constrain timber harvest to a realistic solution.

Other constraint sets, such as the visual and recreation constraints, were modeled in the same manner for all alternatives, but the amount and location of the acreages to which they applied varied by alternative. The combination of different acreage allocations and the different constraint levels results in alternative models with different potential outputs, and different optimal objective function values.

Tradeoffs associated with individual constraints is difficult to assess, because any single constraint's effect is highly dependent on its interaction with other constraints in the model. Where tradeoffs associated with constraints are quantified, they are based on benchmark analyses.

Alternative NC (No Change) is an exception since it is based on a significantly different set of assumptions than the other alternatives, and it could not be modeled with the current Forest FORPLAN model. Chapter II, Alternatives Considered, Alternative NC, describes these differences.

Administratively and Congressionally Removed Areas

In FORPLAN, all forested lands not classified suitable for timber production were designated to the minimum level prescription in all alternatives so that timber harvest would never be scheduled on them. Most of these lands are areas which have been congressionally or administratively withdrawn from timber production and will be managed as unique management areas. See the FEIS, Appendix D and Chapter IV of the Final Forest Plan for the management direction. The following is a list of these areas and their acreages:

Management Area	Acre
1. Wilderness	380,305
2. Oregon Cascade Recreational Area	6,058
3. HJ Andrews Experimental Forest	15,379
4. Research Natural Areas	
Gold Lake Bog RNA	463
Olallie Ridge RNA	720
Middle Santiam RNA	1,145
Wildcat Mountain RNA	1,000
5. Lamb Butte SIA	390
Soils unsuitable for timber harvest ¹	66,890
Water bodies and areas with less than 10% tree cover ¹	140,502

¹ These land areas are not unique management areas.

Legal and Management Requirement Constraints

Wildlife Constraints

Purpose - The purpose of wildlife constraints is to maintain sustaining habitat for all management indicator species and provide additional protection for special habitats not covered by requirements for management indicator species.

Rationale - These acreage constraints prevent the model from harvesting in wildlife habitat areas vital to maintaining viable populations of targeted species.

Tradeoff - Application of the wildlife constraints maintains habitat quality for management indicator species and additional habitat protection for special habitats and sensitive species not selected as management indicators. When constraints protecting the northern spotted owl were applied, the number of final harvest acres was reduced by approximately 6.2% with associated timber volume of 8.6%. When constraints were applied to protect the habitat of the pileated woodpecker and marten, final harvest acres were reduced by approximately 2.5%, with associated reduced timber volume of 2.7%.

Application - MRs for management indicator species were incorporated in the alternative allocations within the grid mapping system, therefore, no explicit FORPLAN constraints were written.

Riparian Constraints

Alternatives W, D, and L use riparian constraints in addition to these constraints required to meet MRs. Purpose, rationale, and tradeoffs for these constraints are discussed under Alternative Descriptions.

Purpose - The model contains two sets of riparian constraints. Each meet a specific management requirement. The purpose of one set is to reduce timber harvest in riparian areas to meet water temperature standards. The second set removes 21.5% of the riparian areas along Class I, II, and III streams from harvest to provide streambank stability.

Rationale - The riparian constraints limit the acres scheduled for harvest in riparian areas to meet State water quality standards and NFMA.

Tradeoff - Application of the riparian constraints maintains water quality and habitat for fish and aquatic life. When the constraints are applied, the number of final harvest acres are reduced by approximately 3.3%, with associated reduced timber volumes of approximately 3.6% and reduced PNV of approximately 3.1%.

Application - Explicit constraints were written to limit harvest in riparian areas to meet water temperature standards; however, acres removed from harvest for streambank stability was done so through the delineation of analysis areas.

Snag Constraints

Two sets of snag constraints were available to the FORPLAN model. The constraints described below ensure MRs are met regarding snags and down logs and are present in all alternatives. The second constraint set is used in alternatives providing snags and down logs above MRs. This second constraint set is discussed under the Alternative Descriptions where applicable.

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Purpose - The purpose of the MR snag constraints is to maintain minimum viable (approximately 20% of biological potential) habitat for primary cavity excavators.

Rationale - These constraints ensure the presence of snags and down logs vital to primary cavity excavators and nesting habitat for other species.

Tradeoff - Application of these constraints maintains quality habitat for primary cavity excavators and other species. When these constraints are applied, the total number of final harvest acres are not necessarily altered; however, timber volume removed from each acre and total PNV are reduced.

Application - These snag requirements were incorporated into the yield tables. Therefore, no explicit constraints were written to meet MRs for snags.

Dispersion Constraints

Purpose - Two sets of dispersion constraints are included in each alternative model formulation. The first constraint set limits final harvest acres to a specified percentage Forest-wide by timber type and size. The second set limits final harvest acres from General Forest to a specified percentage by watershed. The purpose of these constraints is to limit the size of created openings. Dispersion constraints by watershed were combined for the first decade for Alternative W with the hydrologic recovery constraints.

Rationale - The Regional Guide and NFMA place limits on the size of openings that may be created through timber harvest on the National Forests. The dispersion constraints are applied in compliance of these requirements. The Forest-wide constraints approximate an accurate ASQ while dispersion constraints by watershed provide an estimate of spatial limits.

Tradeoff - Application of these constraints reduces model flexibility in selecting prescriptions, resulting in a reduction of the volume of timber produced each decade and a lowered present net value. Application of the dispersion constraints during benchmark analysis resulted in a decrease of 1.5% in timber volumes and a reduced PNV of 5.3%.

On the other hand, application of these constraints ensures that the rate of harvest on a watershed retains forested cutting units between harvest units within each analysis area.

Timber Scheduling Constraints

Long-Term Sustained Yield

Purpose - The long-term sustained yield (LTSY) constraint ensures that the harvest of timber in the last decade is not greater than the long-term timber production capacity of the Forest. Long-term sustained yield capacity is computed using the acreage scheduled to each regeneration prescription applied in the model.

Rationale - To allow conformance with NFMA regulations and ensure the FORPLAN model does not harvest more timber than could be sustained over the long-term.

Tradeoff - The long-term sustained yield constraint limits the flow of harvested timber to a sustainable level. By limiting harvest, economic returns for timber are limited. Additionally, because the removal of timber is controlled, the production of browse and forage in clearcuts is also constrained.

Perpetual Timber Harvest Constraint

Purpose - This constraint ensures that the remaining timber inventory will allow achievement of non-declining harvest levels beyond the modeling horizon. To achieve this condition the constraint requires that the Forest contain as much timber inventory volume at the end of the last period as the Forest would have, on the average, under the management intensities selected in the analysis.

Rationale - To conform with NFMA regulations and to ensure that sufficient timber will remain at the end of the modeling horizon to allow long-term sustained yield.

Tradeoff - By controlling the flow of harvested timber from the Forest, short-term production of timber is reduced.

Harvest Restricted to 95% of Culmination of Mean Annual Increment

Purpose - To ensure production of relatively large sawtimber and to ensure complete site utilization.

Rationale - To prevent the model from harvesting trees smaller than 95% of Culmination of Mean Annual Increment (CMAI). Harvest of smaller trees would mean harvest of trees before the site was completely utilized.

Tradeoff - Removal of this constraint would allow the model greater flexibility in selecting prescriptions which could result in greater harvested volumes and returns and in greater present net values.

Nondeclining Yield

Purpose - The nondeclining yield constraint is applied in nondeparture runs of the model to ensure that the harvest of timber in a decade is greater than or equal to the harvest of timber in the previous period.

Rationale - Application of the nondeclining yield constraint in the model prevents timber volumes from ever declining and allows conformance with NFMA regulation requirements.

Tradeoff - Application of the nondeclining yield constraint provides for a steady or increasing flow of harvested timber from the Forest. Community economic and social stability is due to the controlled flow of timber. The nondeclining yield constraint limits the model to a lower present net value and a reduced flow of timber in early decades.

Operational Constraints

First Period Thinning Constraint

Purpose - To constrain FORPLAN from thinning 13,500 acres recently thinned on the Forest.

Rationale - To allow the FORPLAN model to thin only those acres available for thinning in the first period.

Tradeoff - Application of the thinning constraint provides a more accurate solution of the amount of acres available for thinning in the first decade. Since these acres have already been thinned there is no real loss in timber volume.

DEVELOPMENT AND ANALYSIS OF ALTERNATIVES

Visual and Recreation Constraints

The visual and recreation constraints are applied at different levels and to different land areas, depending on the alternative. The form and purpose of the constraints remain the same in all runs which is why the general form of the constraints is discussed here. The individual constraint levels are discussed in the description of each alternative.

Visual and Recreation Constraints

Purpose - Timber harvesting is allowed on lands where the visual and recreation constraints are applied. These lands are in sensitive scenic areas or are used for recreation purposes. The visual and recreation constraints limit the acres of final timber harvest per period at or below a level consistent with visual or recreational use.

Rationale - These constraints ensure that the harvest rate applied to these areas is consistent with the needs for scenic and recreational experiences.

Tradeoff - Application of these constraints maintains areas of enhanced scenic and recreational quality. The constraints, however, reduce the number of final harvest acres, thereby reducing timber harvests and present net value.

DEVELOPMENT AND ANALYSIS OF ALTERNATIVES

Alternative NC (No Change)

Purpose of the Alternative

The "No Change" Alternative was developed in response to decisions made regarding Appeal Number 1588, brought by the Northwest Forest Resource Council on May 19, 1986. The appeal centered on a decision by Regional Forester James F. Torrence to "require inclusion of minimum management requirements (MMRs) in the No Action Alternative for each Forest Plan." The substance of the appeal was that a "true no-action alternative representing current management plans" was not included in Forest Plan EIS's. In response to this, a No Change Alternative has been developed to represent the existing timber management plan, and consequently does not comply with all provisions of the National Forest Management Act (NFMA) and regulations promulgated by the Secretary of Agriculture to implement NFMA.

Current management plans represented by the No Change Alternative fail to comply with the following NFMA regulations in whole or in part:

- 36 CFR 219.14 - Timber resource land suitability: requires identification of lands not suited for timber production based on risk of irreversible resource damage, lack of assurance of reforestation within five years, or withdrawal by Act of Congress, Secretary of Agriculture, or Chief of Forest Service.
- 36 CFR 219.16 - Requires that all alternatives identify decadal timber harvest levels and long-term sustained yield levels, consistent with the requirements of the RPA program and Regional guide. Also specifies conditions under which departure from nondeclining yield will be considered.

- 36 CFR 219.18 - Requires that Wilderness management direction be provided, including actions needed to limit or distribute visitor use, and measures desirable to protect the Wilderness or adjacent areas from wildfire, insects or disease.
- 36 CFR 219.19 - Provides for viable populations of vertebrate wildlife species, the selection and monitoring of management indicator species, cooperation with wildlife management agencies, and protection of habitat critical to threatened or endangered species.
- 36 CFR 219.23 - Requires full consideration of water and soil resources including estimates of current water uses, instream flow requirements, protection of water quality, watershed condition, and protection of wetland and floodplain values.
- 36 CFR 219.27 - Identifies specific management requirements to be used in the development, analysis, approval, implementation, monitoring and evaluation of forest plans for activities including: silvicultural practices, resource protection, vegetative manipulation, protection of riparian areas, protection of soil and water, and maintenance of diversity.

The timber management plan upon which the No Change Alternative is based was developed in 1977. The plan was not an integrated resource plan, and consequently did not address all resource uses and outputs. The original plan was based on yield tables and resource relationships which do not reflect the latest scientific techniques and information and do not reflect the standards in the NFMA regulations. The timber management plan has been amended following Congressional designations (new Wilderness and Wilderness additions), but there has not been reconciliation of the timber management plan with unit plan direction and requirements of NFMA.

The No Change Alternative could not be implemented or used in future management of the Forest under the Forest Plan without Congressional and/or Secretary of Agriculture action to change the law or regulations.

The No Change Alternative represents continued implementation of the Forest's existing land management and timber management plan. This alternative would: maintain timber outputs equivalent to the potential yield of the 1977 Timber Management Plan and to the extent possible produce current levels and mixes of other resource outputs; and continue policies, standards and guidelines of existing plans. This alternative does not incorporate Management Requirements called for by NFMA.

A detailed description of the Alternative NC goals and objectives are found in Chapter II, Alternative Goals and Management Objectives, of the FEIS document. Several of the major goals and objectives for Alternative NC are summarized below:

- Maintain acres of old-growth in areas administratively and legislatively removed from development and lands unsuited for timber production.
- Emphasize a high to moderate level of scenic quality within the foreground zones of all State and federal highways. The overall scenic quality of the Forest viewshed corridors, however, have a low to moderate emphasis.
- Approximately 88% of the suitable timber will be managed on rotations less than 100 years and the remaining 12% of the acres on rotation ages 100 to 200 years.
- Maintain significant portions of eight inventoried roadless areas and lesser amounts of other inventoried roadless areas in an undeveloped condition.

- Riparian areas would be managed at minimum levels for water quality protection.

Benchmark comparisons, model formulation, and constraint evaluation

The No Change Alternative is based on a significantly different set of assumptions than were the other alternatives and benchmarks and could not be modeled within the current Forest FORPLAN model formulation. The differences are discussed in Chapter II, Alternative Goals and Management Objectives, FEIS. The remaining alternatives in this section are tied to the FORPLAN model formulation, and therefore, comparisons could not be developed for the No Change Alternative.

Alternative K

Purpose of the Alternative

The purpose of Alternative K is to maintain a timber supply level equal to the historical level. The alternative meets all MRs but has a low emphasis on nonmarket values and a high emphasis on commodity production and developed recreation.

This alternative was formulated with input from the Willamette Forestry Council (WFC) and is designed to maintain high levels of timber harvest by making most of the Forest's tentatively suited land available for timber production.

A detailed description of the Alternative K goals and objectives is found in Chapter II, Alternative Goals and Management Objectives of the FEIS document. Several of the major goals and objectives for Alternative K are summarized below:

- Maintain and enhance privately and publicly managed recreation sites to meet increased demand for developed site use.
- Maintain significant portions of 2 inventoried roadless areas in an undeveloped condition.
- Emphasize a moderate to high level of scenic quality within foreground zones along all State and federal highways. The overall scenic quality of Forest viewshed corridors, however, have a low to moderate emphasis.

Alternative Criteria and Assumptions

The following assumptions were made during the formulation of the Alternative K model.

- Timber harvest is scheduled only on lands classified as suitable for timber harvest.
- Timber harvest cannot exceed the long-term sustained yield capacity in any decade.
- Sufficient ending timber inventory must remain at the end of the modeling horizon to sustain timber harvest at the long-term sustained yield capacity.
- Timber harvest cannot decrease in any decade as compared to the immediately preceding decade (NDY).
- Regeneration harvests cannot be scheduled until stands have reached 95% of CMAI.

- Objective function used is to maximize timber volume for the first decade.

Relationships to Issues and Benchmarks

Alternative K maintains significant portions of 2 inventoried roadless areas in an undeveloped condition. In comparison, the maximum recreation benchmark maintains all 100% of the inventoried roadless acres as roadless, while the maximum present net value and maximum timber benchmark maintains no roadless areas.

The first-period timber harvest under the maximum timber benchmark is 118.1 MMCF. Alternative K schedules a 113.9 MMCF first-period harvest.

Alternative K addresses the wildlife and fish habitat issue by providing the required management for spotted owl, marten and pileated woodpecker. Fish habitat is also maintained at required management levels. These habitat levels are identical to the levels in the maximum PNV benchmark run. Effective habitat for deer and elk would be provided by designating High, Moderate, and Low Emphasis Areas. Winter range would be 11% high emphasis, 34% moderate emphasis, and 55% low emphasis. No benchmarks maintain effective habitat for deer and elk with a High, Moderate, and Low Emphasis Areas. Alternative D designates 66% high emphasis, 21% moderate emphasis, and 14% low emphasis.

Dispersed recreation is addressed in Alternative K by providing 48,300 acres for semiprimitive motorized recreation and 14,400 acres for semiprimitive non-motorized recreation. In comparison, the maximum PNV benchmark allocates no acreage to either of these categories, and the maximum recreation benchmark allocates 48,504 acres to semiprimitive motorized recreation and 229,511 acres to semiprimitive nonmotorized recreation.

The scenic quality issue is addressed in Alternative K by allocating 123,600 acres to the modification standard, 147,500 acres to partial retention, and 72,000 acres to retention. This is in contrast to the maximum PNV and maximum timber benchmark run which does not allocate any Forest acres to visual management. The recreation benchmark allocates 565,000 acres to the modification standard, 4,000 acres to partial retention, and 402,000 acres to retention.

Variations from the Standard Model

In order to ensure that the Alternative K FORPLAN model accurately reflected the alternative's intent allocations of land shown in Table B-35 were used as constraints in the model and to delineate analysis areas. The management areas listed in the first part of Table B-35 are not directly entered into the FORPLAN model as a management emphasis. Instead the management areas are broken down in terms of their allowed harvest rate and these harvest rates become the management emphasis.

Table B-35. Alternative K Major Land Allocations

Management Area	Possible Harvest Rates	Acres
Timber	12+%	825,899
Visual	5,6,8,9,A,B	196,044
Recreation	No harvest, 7%	78,324
Wilderness	No harvest	380,805
Wildlife	No harvest	120,345
Riparian	5%, 7%	50,637
Other	No harvest	23,356
Management Emphasis	Level 7 FORPLAN Identifier	Acres
5% harvest rate	55	73,247
7% harvest rate	77	76,681
10% harvest rate	10	32,614
12% harvest rate	12	79,774
Timber (12+%)	TI	702,525
No Harvest	No harvest	710,566

Common Constraints

Complete descriptions of the common constraint sets applied in the Alternative K model are found in Appendix B, Description of Common Constraints. The standard sets of wildlife, snags, riparian, and harvest dispersion constraints were applied in the Alternative K model. Visual and recreation constraints were applied in the Alternative K model. These constraints limit harvest on acres with visual and recreation emphasis to rates of either 5%, 7%, 10%, or 12%. A long-term sustained yield capacity was computed internally by the FORPLAN model during the alternative analysis. This long-term sustained yield constraint, the nondeclining yield constraint, and the perpetual timber harvest constraints were applied in the model. The Alternative K model limits the harvest of timber to within 95% of CMAI of the harvested stand by restricting the earliest age for final harvest entry. The common first-period thinning constraint was also applied in this model.

Unique Constraints

No unique constraints were applied in development of Alternative K.

Alternative A (No Action)

Purpose of the Alternative

Alternative A portrays continued management of the Forest under current direction. This alternative has been designated the "No Action" alternative. The alternative provides no change from the current management of the Forest with the exception of modifying management direction to meet MRs as required under NFMA. Management of the Forest is currently guided by the existing Forest Plan completed in 1977. This alternative uses the land allocations from the 1977 plan as a base, with the addition of MRs for wildlife and riparian areas, and updates on inventories.

This alternative features a blend of resource uses which address to varying degrees the major issues on the Forest. This alternative, emphasizes a high level of timber production wherever compatible with other resource objectives and places low emphasis on roadless recreation and other non-commodity forest uses. Other programs, organization support, and service to the public is at current levels.

A detailed description of the Alternative A goals and objectives is found in the FEIS, Chapter II, *Alternative Goals and Management Objectives*. Several of the major goals and objectives for Alternative A include:

- Maintain significant portions of eight inventoried roadless areas and lesser amounts of other inventoried roadless areas in an undeveloped condition.
- Maintain acres of old growth in areas administratively and legislatively removed from development, lands unsuited for timber production, and areas set aside for riparian and wildlife.
- Emphasize a moderate level of scenic quality within foreground zones of all State and federal highways. The overall scenic quality of Forest viewshed corridors has a low to moderate emphasis.
- Provide full yield from approximately 85% of the suitable timber base at management intensities that are appropriate for the site quality and accessibility and are the most economically efficient. Reduced yields on the remaining 15% of the forest are required to meet quality standards for water, scenery, and dispersed recreation.
- Provide suitable habitat to meet MRs for the northern spotted owl, pileated woodpecker, and marten.

Alternative Criteria and Assumptions

The following assumptions were made during the formulation of the Alternative A model.

- Timber harvesting is scheduled only on lands classified as suitable for timber harvest.
- Timber harvests cannot exceed the long-term sustained yield capacity in any decade.
- Sufficient ending timber inventory must remain at the end of the modeling horizon to sustain timber harvests at the long run sustained yield capacity.
- Timber harvests cannot decrease in any decade as compared to the immediately preceding decade (NDY).
- Regeneration harvests cannot be scheduled until stands have reached 95% CMAI.
- Objective function used is to maximize timber volume for the first decade.

Relationships to Issues and Benchmarks

Alternative A maintains significant portions of eight inventoried roadless and lesser amounts of other inventoried roadless areas in an undeveloped condition. The majority of the Mt. Hagan roadless area is available for multiple-use management including a Research Natural Area and timber harvest. In contrast, the maximum recreation benchmark maintains 100% of the inventoried roadless areas in a roadless condition. The maximum present net value and maximum timber benchmark maintains no roadless areas.

DEVELOPMENT AND ANALYSIS OF ALTERNATIVES

Alternative A addresses the timber supply issue by scheduling 107.2 MMCF of timber for harvest in the first period. This level compares to the maximum timber benchmark which schedules 118.1 MMCF in first-period timber harvest, and the minimum management benchmark which harvests no timber in any decade. In relationship to the old-growth issue, Alternative A retains 528,400 acres of old-growth/large sawtimber at the end of the first period, and 337,000 acres at the end of the fifth. The maximum timber benchmark retains 525,400 acres of old-growth/large sawtimber after the first period, and 306,300 acres after the fifth period. The minimum management benchmark retains at least 870,000 acres of old growth in all periods.

Alternative A addresses the wildlife and fish habitat issue by providing the required management level of habitat for marten and pileated woodpecker. This same level of habitat is allocated in the maximum PNV benchmark run. Effective habitat for deer and elk would be provided by designating High, Moderate, and Low Emphasis Areas. Winter range would be 18% high emphasis, 35% moderate emphasis, and 47% low emphasis. No benchmarks maintain effective habitat with Emphasis Areas. Alternative D allocates 66% to high emphasis, 21% to moderate emphasis, and 14% low emphasis.

Alternative A provides for dispersed recreation by allocating 23,400 acres to semiprimitive motorized recreation and 72,200 acres to semiprimitive nonmotorized recreation. The maximum recreation benchmark allocates 48,504 acres to semiprimitive motorized recreation, and 229,511 acres to semiprimitive nonmotorized recreation. In contrast to these levels, the maximum PNV benchmark run does not allocate any acreage to either of these categories.

The scenic quality issue is addressed in Alternative A by allocation of 4,500 acres of visual corridors on the Forest to modification, 150,100 acres to partial retention, and 77,900 acres to retention. These levels are in contrast to the maximum present net value benchmark which does not allocate any Forest acres to visual management and the recreation benchmark which allocates 565,000 acres to modification standards, 4,000 acres to partial retention, and 402,000 acres to retention standards.

Variations from the Standard Model

In order to ensure that the Alternative A FORPLAN model accurately reflected the current plan (with the addition of MRs), allocations of land (shown in Table B-36) were used to derive constraints in the model and to delineate analysis areas. The management areas listed in the first part of Table B-36 are not directly entered into the FORPLAN model as a management emphasis. Instead the management areas are broken down in terms of their allowed harvest rate and these rates become the management emphasis.

Table B-36. Alternative A (No Action) Major Land Allocations

Management Area	Possible Harvest Rates	Acres
Timber	12+%	880,225
Visual	5%, 7%, 10%	118,723
Recreation	No harvest, 5%, 7%, 10%	113,966
Wilderness	No harvest	380,805
Wildlife	No harvest	109,551
Riparian	5%, 7%, 10%,	47,993
Other	No harvest	24,167
Management Emphasis	Level 7 FORPLAN Identifier	Acres
5% harvest rate	55	66,208
7% harvest rate	77	76,852
10% harvest rate	10	11,134
Timber (12+%)	TI	749,195
No Harvest	00	772,041

Common Constraints

Complete descriptions of the common constraint sets applied in the Alternative A model are found in Appendix B, Description of Common Constraints. The standard sets of wildlife, snags, riparian, and harvest dispersion constraints were applied in the Alternative A model. Visual and recreation constraints were also present in the Alternative A model. These constraints limit harvest on areas with visual and recreation emphasis to rates of either 5%, 7%, and 10%. A long-term sustained yield capacity was computed internally by the FORPLAN model during the alternative analysis. The long-term sustained yield constraint, nondeclining yield constraints and a perpetual timber harvest constraint were also applied in the model. The Alternative A model limits the harvest of timber to within 95% of CMAI of the harvested stand by restricting the earliest age for final harvest entry. The common first-period thinning constraint was also applied in this model.

Unique Snag Constraints

In addition to MRs (see Description of Common Constraints), snags were left equivalent to 40% of the biological potential of each watershed.

Purpose - To achieve a level of habitat quality for primary cavity excavators (PCE) equivalent to 40% of the biological potential of each subbasin.

Rationale - Addition of these constraints allows habitat quality consistent with Alternative A goals and objectives and accurate estimation of the effect on timber harvest volume.

Tradeoffs - This constraint does not reduce the final harvest acres but reduces the volume of timber removed from final harvest acres.

Alternative J

Purpose of the Alternative

Alternative J represents a moderate emphasis on nonmarket resources and a moderate emphasis on commodity production. The focus of Alternative J is to balance the timber, roadless area, old-growth, fish and wildlife, and scenery issues in a way that provides some degree of resolution for each.

A detailed description of the Alternative J goals and objectives is found in Chapter II, Alternative Goals and Management Objectives, FEIS. Several of the major goals and objectives for Alternative J are summarized below:

- Continue Wilderness management at current levels while expanding existing capacity of publicly managed sites.
- Maintain significant portions of 13 inventoried roadless areas and lesser amounts of other inventoried roadless areas in an undeveloped condition.
- Ensure no landscape alterations are evident in foreground areas of all State and Federal highways, major forest roads, and selected trails.
- Maintain old-growth acres administratively and legislatively removed from development, land unsuited for timber production, and areas set aside for riparian and wildlife MRs for at least fifty years.
- Provide full timber yields on 720,000 acres of the suitable forest land and reduced levels of timber production on 133,000 acres.

Alternative Criteria and Assumptions

The following assumptions were made during the formulation of the Alternative J model:

- Timber harvest is scheduled only on lands classified as suitable for timber harvest.
- Timber harvest cannot exceed the long-term sustained yield capacity in any decade.
- Sufficient ending timber inventory must remain at the end of the modeling horizon to sustain timber harvest at the long-term sustained yield capacity.
- Timber harvest cannot decrease in any decade as compared to the immediately preceding decade (NDY).
- Regeneration harvests cannot be scheduled until stands have reached 95% of CMAI.
- Objective function used is to maximize timber volume for the first decade.

Relationships to Issues and Benchmarks

Alternative J maintains 341,400 acres, or 57%, of the inventoried unroaded acres in an unroaded condition. By comparison, the maximum present net value benchmark run reserves no roadless areas,

and the maximum recreation benchmark retains 100% of the inventoried roadless areas in roadless condition. Under the maximum recreation benchmark, 210,000 acres of roadless area are retained.

Alternative J addresses the timber supply issue by harvesting 92.3 million cubic feet (MMCF) of timber in both the first and fifth periods. This is in contrast to the maximum timber benchmark which harvests 118.1 MMCF in both the first and fifth periods. Alternative J addresses the old-growth issue by retaining 534,900 acres of old-growth after the first period, and 341,100 acres after the fifth period. The maximum timber benchmark retains 525,450 acres of old-growth after one period and 306,290 acres after five periods.

The wildlife habitat issue is addressed by providing the required management level of habitat for marten and pileated woodpecker. These are the same levels that are applied in the maximum present net value benchmark. Alternative J provides for 59 spotted owl management areas excluding Wilderness. Alternative L, which provides the most habitat for interior wildlife species of any alternative or benchmark, maintains 59 SOHAs and habitat capability for 219 pairs Forest-wide, and management requirement levels of habitat for marten and pileated woodpecker. Effective habitat for deer and elk would be provided by designating High, Moderate, and Low Emphasis Areas. Winter range would be 35% high emphasis, 26% moderate emphasis, and 39% low emphasis. No benchmarks maintain effective habitat through the use of Emphasis Areas. Alternative D allocates 66% to high emphasis, 21% to moderate emphasis, and 14% to low emphasis.

Dispersed recreation is provided for in Alternative J by allocating 31,300 acres to motorized semiprimitive recreation use and 89,500 acres to nonmotorized semiprimitive recreation use. These levels are in contrast to the maximum recreation benchmark which allocates 48,504 acres to semiprimitive motorized recreation and 229,511 acres to semiprimitive nonmotorized recreation or in comparison to the maximum present net value benchmark which does not allocate any acreage to either of these categories.

The scenic quality issue is addressed in Alternative J by allocating 206,200 acres to modification visual standards, 177,700 acres of visual corridors to partial retention standards, and 90,500 acres to retention standards. These levels are in contrast to the maximum present net value benchmark which does not allocate any Forest acres to visual management and the recreation benchmark which allocates 565,000 acres to modification standards, 4,000 acres to partial retention, and 402,000 acres to retention standards.

Variations from the Standard Model

In order to ensure that the Alternative J FORPLAN model accurately reflected the alternative's intent, allocations of land (shown in Table B-37) were used as constraints in the model and used to delineate analysis areas. The management areas listed in the first part of Table B-37 are not directly entered into the FORPLAN model as a management emphasis. Instead, the management areas are broken down in terms of their allowed harvest rate and these harvest rates become the management emphasis.

Table B-37. Alternative J Major Land Allocations

Management Area	Possible Harvest Rates	Acres
Timber	12+%	611,247
Visual	5%, 7%, 10%, 12%	343,327
Recreation	No harvest, 5%, 7%, 10%	156,244
Wilderness	No harvest	380,805
Wildlife	No harvest	111,812
Riparian	5%, 7%, 10%	45,389
Other	No harvest	26,577
Management Emphasis	Level 7 FORPLAN Identifier	Acres
5% harvest rate	55	68,085
7% harvest rate	77	78,388
10% harvest rate	10	42,681
12% harvest rate	12	174,778
TI (12+%)	TI	518,554
No Harvest	00	792,921

Common Constraints

Complete descriptions of the common constraints sets applied in Alternative J model are found in this section under, Description of Common Constraints. The standard sets of wildlife, snags, riparian, and harvest dispersion constraints were applied in the Alternative J model. Visual and recreation constraints were also present in the Alternative J model. These constraints limit harvest on the different areas with visual and recreation management emphasis to rates of either 5%, 7%, 10%, or 12%, consistent with the alternative objectives. The standard first-period thinning acreage constraint was also applied in the model. The Alternative J model limited the harvest of timber to within 95% of CMAI by restricting the earliest age for harvest. A long-term sustained yield constraint which uses an internally computed sustained yield was used along with nondeclining yield constraints to regulate harvesting in the model.

Unique Constraints Snag constraints

In addition to MRs (see previous subsection, Description of Common Constraints), snags were left equivalent to 40% of the biological potential of the site.

Purpose - To achieve a level of habitat quality for PCE equivalent to 40% of the habitat potential of the site.

Rationale - Addition of these constraints ensure the FORPLAN model meets the alternative objectives of snag levels and allows the impact on timber harvest to be evaluated.

Tradeoff - These constraints do not reduce the final harvest acres but reduce the volume of timber removed from final harvest acres.

Unique Big-game constraints

Purpose - These constraints assure Alternative J, being the DEIS Preferred Alternative, meets the MRs set forth in the DEIS.

Rationale - To meet Alternative J goals and objectives for assuring habitat effectiveness for deer and elk.

Tradeoff - These constraints were incorporated into the analysis areas directly removing acres from the timber base and reducing the model's ability to assign final harvest acres.

Alternative W

Purpose of the Alternative

The focus of Alternative W is to provide a healthy, diverse, and productive ecosystem that will ensure the capability of the Forest to produce a continuous flow of a variety of goods and services to the public over the long term.

Alternative W provides direction for continued dependable supply of timber to the market while providing for a wide range of non-commodity uses of the Forest.

A detailed description of the goals and objectives for Alternative W is listed in Chapter II, Alternative Goals and Objectives, FEIS. Several of the major goals and objectives for Alternative W are summarized below:

- Maintain all existing recreation sites under the current mix of public and private management and expand the existing capacity of publicly managed sites. Maintain significant portions of the Forest's semiprimitive dispersed recreation opportunities in an undeveloped condition.
- Maintain significant portions of 13 inventoried roadless areas and lesser amounts of other roadless areas in an undeveloped condition.
- Ensure no landscape alterations are evident in foreground areas of all State and federal highways, major forest roads, and selected trails. Emphasize moderate level of scenic quality within major viewshed corridors.
- Provide for full timber yields on 689,000 acres of the suitable land base and reduced levels of timber production on 85,000 acres. (total 774,608)
- Provide suitable habitat to meet MRs for the northern spotted owl, pileated woodpecker, and marten.
- Maintain or improve water quality to levels which meet or exceed the needs of the beneficial uses of the water.

Alternative Criteria and Assumptions

The following assumptions were made during the formulation of the Alternative W model:

- Timber harvest is scheduled only on lands classified as suitable for timber harvest.
- Timber harvest cannot exceed the long-term sustained yield capacity in any decade.

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- Sufficient ending timber inventory must remain at the end of the modeling horizon to sustain timber harvest at the long-term sustained yield capacity.
- Timber harvest cannot decrease in any decade when compared to the immediately preceding decade (NDY).
- Regeneration harvests cannot be scheduled until stands have reached 95% of CMAI.
- Objective function used is to maximize timber volume for the first decade of the modeling horizon.

Relationships to Issues and Benchmarks

In relation to the roadless lands issue, Alternative W maintains 53% of the inventoried roadless acres in an unroaded condition. In contrast, the maximum recreation benchmark maintains 100% of the inventoried roadless acres as roadless, while the maximum present net value and maximum timber benchmarks maintain no roadless areas.

Alternative W addresses the timber supply issue by harvesting 84.8 million cubic feet (MMCF) of timber in both the first and fifth periods. This is in contrast to the maximum timber benchmark which harvests 118.1 MMCF in both the first and fifth periods. Alternative W addresses the old-growth issue by retaining 533,000 acres of old-growth after the first period, and 365,200 acres after the fifth period. The maximum timber benchmark retains 525,450 acres of old growth after one period and 306,290 acres after five periods.

The wildlife habitat issue is addressed by providing the required management level of habitat for marten and pileated woodpecker. These are the same levels that are applied in the maximum present net value benchmark. Alternative W provides for 94 spotted owl management areas including Wilderness. Alternative L which provides the most habitat for interior wildlife species of any alternative or benchmark maintains a total of 219 spotted owl management areas and required management levels of habitat for marten and pileated woodpecker. Effective habitat for deer and elk would be provided by designating High, Moderate, or Low Emphasis Areas. With Alternative W winter range would be 31% high emphasis, 46% moderate emphasis, and 23% low emphasis. No benchmarks use maintain effective habitat through the use of Emphasis Areas. Alternative D allocates 66% to high emphasis, 21% low emphasis, and 14% low emphasis.

Dispersed recreation is provided in Alternative W by allocating 36,048 acres of forest to motorized semiprimitive recreation use, and 85,768 acres to nonmotorized semiprimitive recreation use. These levels are in contrast to the maximum recreation benchmark which allocates 48,504 acres of the Forest to nonmotorized recreation. In comparison to these levels, the maximum present net value benchmark does not allocate any acreage to either of these categories.

The scenic quality issue is addressed in Alternative W by allocating 143,000 acres of visual corridors to modification visual standard, 171,700 acres of visual corridors to partial retention, and 118,800 acres to retention status. These levels are in contrast to the maximum present net value benchmark which does not allocate any Forest acres to visual management and the recreation benchmark which allocates 565,000 acres to modification standards, 4,000 acres to partial retention, and 402,000 acres to retention standards.

Variations from the Standard Model

To ensure that the Alternative W FORPLAN model accurately reflected the alternative's intent, allocations of land shown in Table B-38 were used to derive constraints in the model and delineate analysis areas. The management areas listed in the first part of Table B-38 are not directly entered into the FORPLAN model as a management emphasis. Instead the management areas are broken down in terms of their allowed harvest rate and these harvest rates become the management emphasis.

Table B-38. Alternative W Major Land Allocations

Management Area	Possible Harvest Rates	Acres
Timber	12+%	646,981
Visual	5%, 7%, 10%, 12%	277,439
Recreation	No harvest, 5%, 7%, 10%	166,673
Wilderness	No harvest	380,805
Wildlife	No harvest	125,953
Riparian	No harvest	50,522
Other	No harvest	27,004
Management Emphasis	Level 7 FORPLAN Identifier	Acres
5% harvest rate	55	44,298
7% harvest rate	77	44,814
10% harvest rate	10	62,638
12% harvest rate	12	114,184
Timber (12+%)	TI	542,817
No Harvest	00	866,655

Common Constraints

Complete descriptions of the common constraint sets applied in the Alternative W model are found in Appendix B, Description of Common Constraints. The standard sets of wildlife, snags, riparian, and harvest dispersion constraints were applied in the Alternative W model. Visual and recreation constraints were also present in the Alternative W model. These constraints limit harvest on areas with visual and recreation emphasis to rates of either 5%, 7%, 10%, or 12%. The Alternative W model limited the harvest of timber to within 95% of the CMAI by restricting the earliest age for harvest. Long-term sustained yield capacity was computed internally by the FORPLAN model during the alternative analysis. The nondeclining yield constraint, perpetual timber harvest constraint, and the first-period thinning constraints were also applied in this model.

Unique Constraints

Unique Aggregated Recovery Percentage Constraint

Peak flows resulting from rain-on-snow events may be significantly increased through creation of openings during timber harvest, adversely affecting the condition of a watershed. To quantitatively evaluate the condition of a watershed a measure termed Aggregate Recovery Percentage (ARP) has been developed. For a detailed discussion on ARP refer to this Appendix, The Forest Planning Model,

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Yield Coefficients. ARP has been used in the Alternative W model as a method of constraining the model to maintain or improve water quality.

Purpose - The purpose of these constraints is to protect streambank and stream channel stability as a method of maintaining or improving water quality.

Rationale - These constraints are a method to meet Alternative W goals and objectives for maintaining or improving water quality.

Tradeoff - These constraints were applied for decades 2 through 15, therefore, first-period timber harvest was not affected. These constraints however, limited the prescriptions chosen by the model lowering final harvest acres and timber volume for future decades.

Unique First-period Riparian Constraints

Purpose - The purpose of these constraints is to protect streambank and stream channel stability while incorporating the use of harvest dispersion.

Rationale - Prevented opportunities for FORPLAN to violate modeling assumptions on the subdrainage level that existed when ARP and harvest dispersion were not considered together.

Tradeoff - These absolute constraints were applied for the first-period only, directly reducing the final harvest acres and volume removed in the first decade.

Riparian and Wildlife Constraints

Purpose - The purpose of these constraints was to increase effectiveness on winter range for deer and elk, and to limit harvest on unstable landtypes adjacent to Class IV streams.

Rationale - To reduce the risk of winter mortality by preventing the model from harvesting optimal cover on winter range for deer and elk and to minimize the risk of debris torrents by retaining trees needed for the stability of potentially unstable landtypes.

Tradeoff - These absolute constraints were applied during the first-period, directly reducing the final harvest acres and total volume removed.

Unique Class I, II, III Riparian Constraints

Purpose - The purpose of these constraints was to prohibit timber harvest around Class I, Class II, and Class III streams and lakes.

Rationale - By prohibiting the harvest of timber in these areas, water quality and fish habitat quality are maintained or improved, meeting the alternative goals and objectives.

Tradeoff - A majority of these acres were removed from the timber base (with the exception of those acres already removed for MRs) directly reducing the final harvest acres and volume harvest.

Application - These constraints were represented in the model by shifting all acres normally allocated to riparian harvest prescriptions to analysis areas prohibiting timber harvest.

Alternative D

Purpose of the Alternative

Alternative D combines a high emphasis on nonmarket resources with the need for commodity production. Alternative D was brought forward from the DEIS to provide a continuous range of responses to significant public issues.

A detailed description of the Alternative D goals and objectives are found in Chapter II, Alternative Goals and Management Objectives of the FEIS document. Several of the major goals and objectives for Alternative D are summarized below:

- Maintain a high level of scenic quality throughout the Forest.
- Exceed MRs for fish and wildlife habitat. Provide suitable habitat for 137 pairs of spotted owls.
- Provide for timber production with full yields on 639,000 acres of the total suitable acres. Providing for a reduced level of timber production on the remaining 80,000 acres of the Forest in order to meet quality standards for water, scenery, and dispersed recreation.
- Maintain significant portions of most inventoried roadless areas, and lesser amounts of other inventoried roadless areas in an undeveloped condition. Expanding the number of Research Natural Areas by adding four new areas for a total of eight.

Alternative Criteria and Assumptions

The following assumptions were made during the formulation of the Alternative D model:

- Timber harvest is scheduled only on lands classified as suitable for timber harvest.
- Timber harvest cannot exceed the long-term sustained yield capacity in any decade.
- Sufficient ending timber inventory must remain at the end of the modeling horizon to sustain timber harvest at the long-term sustained yield capacity.
- Timber harvest cannot decrease in any decade as compared to the immediately preceding decade (NDY).
- Regeneration harvests cannot be scheduled until stands have reached 95% CMAI.
- Objective function used is to maximize timber volume for the first period of the model horizon.

Relationships to Issues and Benchmarks

Alternative D addresses the roadless lands planning issue by maintaining 80% of all inventoried roadless areas in an unroaded condition. This is in contrast to the maximum recreation benchmark which maintains 100% of the inventoried roadless areas as roadless and in contrast to the maximum present net value and maximum timber benchmarks which allocate no land to roadless areas.

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In relation to the timber supply issue, Alternative D harvests 83.6 million cubic feet (MMCF) of timber in the first period. This is in contrast to the maximum timber benchmark which harvests 118.1 MMCF in the first period and the minimum management benchmark which harvests no timber in any period.

The wildlife habitat issue is addressed in Alternative D by exceeding MRs for marten and pileated woodpecker habitat and providing 26 bald eagle sites. Out of a total inventory of 219 spotted owl pairs, 137 are maintained in Alternative D. Effective habitat for deer and elk would be provided by designating High, Moderate, or Low Emphasis Areas. With Alternative D winter range would be 66% high emphasis, 21% moderate emphasis, and 14% low emphasis. No benchmarks maintain effective habitat through the use of Emphasis Areas.

Dispersed recreation opportunities are provided in Alternative D by allocating 38,245 acres of land to semiprimitive motorized recreation and 176,484 acres to semiprimitive nonmotorized recreation. These levels compare to the maximum recreation benchmark which allocates 48,504 acres to semiprimitive motorized recreation and 229,511 acres of Forest to nonmotorized recreation. In contrast to these levels, the maximum PNV benchmark does not allocate any acreage to either of these categories.

The scenic quality issue is addressed by allocating 108,400 acres of visual corridors managed to modification standards, 245,700 acres to partial retention, and 142,100 acres to retention. These levels are in contrast to the maximum present net value benchmark which does not allocate any Forest acres to visual management and the recreation benchmark which allocates 565,000 acres to modification standards, 4,000 acres to partial retention, and 402,000 acres to retention standards.

Variations from the Standard Model

In order to ensure that the Alternative D FORPLAN model accurately reflected the Alternative's intent, allocation of land shown in Table B-39 were used to derive constraints in the model and delineate analysis areas. The management areas listed in the first part of Table B-39 are not directly entered into the FORPLAN model as a management emphasis. Instead the management areas are broken down in terms of their allowed harvest rate and these harvest rates become the management emphasis.

Table B-39. Alternative D Major Land Allocations

Management Area	Possible Harvest Rates	Acres
Timber	12+%	497,525
Visual	5%, 7%, 10%, 12%	313,965
Recreation	No harvest, 5%, 7%, 10%	253,156
Wilderness	No harvest	380,805
Wildlife	No harvest	162,245
Riparian	No harvest, 5%	47,991
Other	No harvest	25,937
Management Emphasis	Level 7 FORPLAN Identifier	Acres
5% harvest rate	55	81,310
7% harvest rate	77	52,834
10% harvest rate	10	118,190
12% harvest rate	12	91,058
Timber (12+%)	TI	445,481
No Harvest	00	876,535

Common Constraints

Descriptions of these constraints can be found earlier in this section under Description of Common Constraints. The standard sets of riparian, snags, wildlife, and harvest dispersion constraints were applied in the Alternative D model. Visual and recreation constraints were also present in the Alternative D model. These constraints limit harvest on different management areas with visual or recreation emphasis to rates of either 5%, 7%, 10%, or 12% consistent with the alternative objectives. The standard first-period maximum thinning acreage constraint was included in the model. The Alternative D model limits the harvest of timber to within 95% of CMAI by restricting the earliest age for harvest. The internally computed long-term sustained yield constraint and the perpetual timber harvest constraint were also applied in the model.

Unique Class I and Class II Riparian Constraints

Purpose - The purpose of these constraints was to prohibit timber harvest in riparian areas around Class I and Class II streams.

Rationale - By prohibiting the harvest of timber in these areas, water and fish habitat quality are maintained or improved meeting the alternatives objectives.

Tradeoffs - Application of these constraints improves water quality and riparian habitat for many wildlife species. Final harvest acres are, however, reduced in these areas, thereby reducing total timber volume and present net value.

Application - This condition was represented in the model by shifting all acres normally allocated to riparian harvest prescriptions to analysis areas which prohibit timber harvesting.

Unique Class III Riparian Constraints

Purpose - The purpose of these constraints was to limit the final harvest rate on Class III streams to 5% per decade.

Rationale - By limiting the harvest of timber in riparian areas around Class III streams and lakes, water and fish habitat quality are maintained or improved meeting the alternative's objectives.

Tradeoff - Application of these constraints improves water quality and riparian habitat for many wildlife species. Final harvest acres are reduced, thereby reducing total timber volume and present net value.

Application - Because the Class III riparian constraints were similar to the visual and recreation constraints, these constraints were incorporated into the standard set of visual and recreation constraints.

Unique Aggregated Recovery Percentage (ARP) Constraint

Purpose - The purpose of this constraint is to protect streambank and stream channel stability through the dispersal of harvest units.

Rationale - These constraints are a method to meet Alternative D goals and objectives for maintaining or improving water quality.

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Tradeoff - These constraints were applied for decades 2 through 15; therefore, first-period timber harvest was not affected. These constraints did, however, limit the prescriptions chosen by the model, lowering final harvest acres and timber volume for future decades.

Unique Wildlife Constraints

Purpose - In addition to the MRs (see previous subsection Description of Common Constraints) the purpose of these constraints was to model the following wildlife objectives:

- Provide suitable habitat exceeding MRs for the northern spotted, pileated woodpecker, and marten.
- Provide 6 additional bald eagle areas with no harvest prescriptions.
- Increase habitat effectiveness on winter range for deer and elk, reducing the risk of winter mortality.

Rationale - These acreage constraints prevent the model from harvesting in wildlife habitat areas, thereby decreasing the risk of winter mortality.

Tradeoff - These first-period constraints provide higher quality habitat for a diverse array of wildlife species. However, when applied, these constraints reduce final harvest acres and consequently volume harvested.

Unique Snag Constraints

Purpose - To achieve a level of habitat quality for PCE equivalent to 60% of the biological potential.

Rationale - Addition of these constraints allows improved habitat quality for PCE consistent with Alternative D goals and objectives.

Tradeoff - This constraint does not reduce the final harvest acres but reduces the volume of timber removed from final harvest acres.

Alternative L

Purpose of the Alternative

Alternative L places a high emphasis on nonmarket values and low emphasis on timber commodity values. This alternative preserves areas currently not highly affected by past management activities in their natural condition and proposes other areas for natural recovery from the effects of past management. Alternative L was formulated with input from the Oregon Natural Resources Council (ONRC).

A detailed description of the Alternative L goals and objectives is found in Chapter II, Alternative Goals and Management Objectives, FEIS. Several of the major goals and objectives are summarized below:

- Provide the maximum amount of motorized and nonmotorized area for semiprimitive recreation opportunities.
- Emphasize a high level of scenic quality throughout the Forest.

- Maintain all inventoried roadless in an undeveloped condition and recommend several roadless areas to Wilderness status.
- Provide for full timber yields on 314,000 acres and reduced level of timber production on 239,000 acres.
- Provide suitable habitat that would exceed MRs for the northern spotted owl, pileated woodpecker, and marten.
- Manage riparian areas above minimum level for water quality to aid in the recovery of current stream conditions and to meet objectives for other riparian resources.

Alternative Criteria and Assumptions

The following assumptions were made during the formulation of the Alternative L model:

- Timber harvest is scheduled only on lands classified as suitable for timber harvest.
- Timber harvest cannot exceed the long-term sustained yield capacity in any decade.
- Sufficient ending timber inventory must remain at the end of the modeling horizon to sustain timber harvest at the long-term sustained yield capacity.
- Timber harvest cannot decrease in any decade when compared to the immediately preceding decade (NDY).
- Regeneration harvests cannot be scheduled until stands have reached 95% of CMAI.
- Objective function used is to maximize timber volume for the first decade harvest.

Relationships to Issues and Benchmarks

Alternative L addresses the roadless area planning issue by maintaining all 145,900 acres, or 85%, of the inventoried roadless areas on the Forest as roadless. Alternative L maintains the greatest amount of roadless areas of any alternative or benchmark. This level of roadless area maintenance is in contrast to the maximum present net value and maximum timber volume benchmarks which retain no roadless areas.

Alternative L harvests 26.4 million cubic feet (MMCF) of timber during the first period. This is in contrast to the maximum timber benchmark which harvests 118.1 MMCF of timber in the first decade, and the minimum management benchmark which harvests no timber in any decade.

The wildlife and fish habitat issues are addressed directly in Alternative L. The full spotted owl habitat area inventory outside of Wilderness (184 areas) is provided in this alternative. Effective habitat for deer and elk would be provided by designating High, Moderate, and Low Emphasis Areas. With Alternative L winter range would be 41% high emphasis, 42% moderate emphasis, and 17% low emphasis. No benchmarks maintain effective habitat through the use of Emphasis Areas. Alternative D allocates 66% to high emphasis, 21% to moderate emphasis, and 14% to low emphasis.

Dispersed recreation is provided in Alternative L by allocating 102,000 acres to semiprimitive nonmotorized recreation and 66,300 acres to semiprimitive motorized recreation. These levels can be

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compared to the maximum recreation benchmark which allocates 229,446 acres to semiprimitive nonmotorized recreation and 48,489 acres to semiprimitive motorized recreation, or the maximum PNV benchmark which does not to allocate any acreages to either of these categories.

The scenic quality issue is addressed directly in Alternative L. Alternative L allocates 4,500 acres to modification standards, 286,300 acres to partial retention standards, and 265,100 acres to retention standards. These levels are in contrast to the maximum present net value benchmark which does not allocate any Forest acres to visual management and the recreation benchmark which allocates 565,000 acres to modification standards, 4,000 acres to partial retention, and 402,000 acres to retention standards.

Variations from the Standard Model

To ensure that the Alternative L FORPLAN model accurately reflected the alternative's intent, the allocations of land shown in Table B-40 were used to derive constraints in the model and delineate analysis areas. The management areas listed in the first part of Table B-40 are not directly entered into the FORPLAN model as a management emphasis. Instead the management areas are broken down in terms of their allowed harvest rate and these harvest rates become the management emphasis.

Alternative L is the only alternative that differs in the established harvest rates. This alternative makes use of the harvest rates used in previous alternatives and in addition uses 1%, 4%, and 6% harvest rates.

Table B-40. Alternative L Major Land Allocations

Management Area	Possible Harvest Rates	Acres
Timber	10%, 12+%	195,190
Visual	No harvest, 1%, 4%, 5%	358,088
Recreation	No harvest, 5%, 7%,	401,004
Wilderness	No harvest	550,165
Wildlife	No harvest, 3%	92,146
Riparian	No harvest	43,600
Other	No harvest	22,077
Management Emphasis	Level 7 FORPLAN Identifier	Acres
1% harvest rate	11	11,774
3% harvest rate	33	64,886
4% harvest rate	44	65,739
5% harvest rate	55 F	25,212
6% harvest rate	66	50,979
7% harvest rate	77	25,383
10% harvest rate	10	179,748
Timber (12+%)	TI	142,484
No Harvest	00	1,113,063

Common Constraints

Complete descriptions of the common constraints sets applied in Alternative L model are found in Appendix B, Description of Common Constraints. The standard sets of wildlife, snags, riparian, and

harvest dispersion constraints were applied in the Alternative L model. Visual and recreation were also present in the Alternative L model. These constraints limit harvest on areas of visual and recreation emphasis to rates of either 1%, 3%, 4%, 5%, 6%, 7%, or 10%. The standard first-period maximum thinning acreage constraint was also included in the model. The Alternative L model limits the harvest of timber to within 95% of CMAI by restricting the earliest age available for harvest. The internally computed long-term sustained yield constraint, nondeclining yield, and the perpetual timber harvest constraint were also applied in the model.

Unique Class I, II, III, and IV Constraints

Purpose - The purpose of these constraints is to prohibit timber harvest around Class I, II, III, and IV streams and lakes.

Rationale - By prohibiting the harvest of timber in these areas, water quality and fish habitat quality are maintained or improved, meeting the alternative objectives.

Tradeoff - A majority of these acres were removed from the timber base (the exception being those acres removed for MRs), directly reducing the final harvest acres and volume harvested.

Application - This condition was represented in the model by shifting all acres normally allocated to the standard riparian harvest prescription to the riparian no harvest analysis areas.

Unique Aggregated Recovery Percentage Constraint

Purpose - The purpose of this constraint is to protect streambank and stream channel stability as a method of maintaining or improving water quality.

Rationale - To meet Alternative L goals and objectives for maintaining or improving water quality.

Tradeoff - These constraints were applied for decades 2 through 15; therefore, first-period timber harvest was not affected. These constraints limited the prescriptions chosen by the model, lowering final harvest acres and timber volume for future decades.

Unique Timber Harvesting Constraint

Purpose - The purpose of this constraint is to limit harvest to rates between 1% and 10% thereby lengthening rotation.

Rationale - To meet the alternative goals and objectives for maintaining connectivity and old-growth characteristics in forested stands.

Tradeoff - Maintaining an interconnection of high quality habitats provides a healthy environment for the growth of a diverse array of wildlife populations. When these constraints are applied, however, there is a drastic reduction in final harvest acres and volume, resulting in a decrease in PNV.

ESTIMATING EFFECTS OF BENCHMARKS, DISCRETIONARY CONSTRAINTS, AND ALTERNATIVES

The purpose of identifying and estimating the effects of each benchmark, alternative, and discretionary constraint was to find the most cost efficient means of addressing planning issues. A comparative analysis among alternatives is the basis for evaluating alternatives and selecting a preferred alternative. This section focuses on the differences among alternatives in terms of outputs and effects, objectives and constraints, and economic efficiency of alternatives. Some key items of the benchmarks are also discussed as a reference points for explaining these differences. For a more complete discussion of the rationale and tradeoffs of individual constraints see the previous section of this appendix, *Formulation of Alternatives*. See FEIS Chapter IV for a complete discussion of the environmental effects.

First, the process for evaluating constraints is discussed. Then, the alternatives are compared in terms of response to issues, concerns and opportunities (ICOs) and in terms of several economic criteria. In the final part of this section, the reasons for economic differences among the alternatives are compared with the differences between outputs and effects.

Process for Evaluating Significant Constraints

Management objectives of benchmarks and alternatives were achieved by constraining FORPLAN as described in the previous sections (*Analysis Prior to the Development of Alternatives* and *Formulation of Alternatives*). The opportunity cost of individual objectives can be determined by comparing a FORPLAN solution which achieves a specific objective with a solution which does not. When all other objectives are the same, the difference in outputs and effects is the opportunity cost of achieving the objective.

Opportunity costs were not determined for all individual alternative objectives because of the prohibitive costs of analyzing every constraint used to develop alternatives. Instead, the economic tradeoffs of sets of objectives were determined by comparing alternatives. These efficiency tradeoffs were then compared to environmental and social consequences to help identify the alternative which maximizes net public benefits.

During benchmark analysis, constraint sets which were needed to meet MRs were developed and evaluated. The constraints were analyzed both individually and collectively to determine the magnitude of their tradeoffs. The policy constraints associated with nondeclining yield and rotations based on CMAI were also evaluated to determine their effects on PNV and timber output levels. The results of the analyses of MRs and legal and policy constraints are presented in the *Analysis of the Management Situation*, Chapter II, and in Section F of this Appendix.

The tradeoffs discussed in this section are only relevant to the actual alternative where the objectives were analyzed because the opportunity costs are dependent on the order in which the objectives were added. For example, the economic tradeoff of meeting management objectives A and B can be determined by comparing FORPLAN solutions with various combinations of the two objectives. The changes in PNV due to meeting only A may be \$5 million, and the change due to meeting B may be \$11 million. However, taken together, the opportunity cost may not necessarily be the sum of A and B due to the degree to which these objectives overlap or duplicate themselves. In addition, the cost of meeting objective A in one alternative will not necessarily be the same as meeting the same objective in another alternative.

Economic Comparison of Alternatives and Benchmarks

Present Net Value

PNV is the primary measure of economic efficiency of the alternatives. It is the sum of priced values less all management costs discounted to the present at 4% per year. This analysis includes benefits and costs on the Forest as if the direction of each benchmark and alternative were to continue for 150 years, even though the period covered by a Forest Plan will be 10 to 15 years. For more explanation on the assumptions and procedures used to estimate economic consequences, see a previous section of this appendix, *Economic Efficiency Analysis*.

Table B-41 displays the incremental changes in PNV, and associated costs and benefits between alternatives and between benchmarks. The alternatives and benchmarks are ranked in order of decreasing PNV. The incremental changes in PNV are a measurement of the net economic values of the priced resources that would be foregone if a lower-ranked alternative is selected over a preceding one. The foregone economic value must be weighed against the nonpriced benefits of the alternative. Information on the benchmarks is included as reference points on the Forest resources under regimes which maximize the production of one resource or value.

The incremental changes in costs, benefits, and PNV of the alternatives and benchmarks are displayed again in Table B-42, only in order of increasing costs. The incremental changes in costs are a measure of the additional discounted cost that would be required to implement a more expensive alternative. The marginal cost must be weighed against the priced benefits and the nonpriced outputs and effects of the alternative.

The PNV of the alternatives range from \$3.5 billion for Alternative K to \$1.6 billion for Alternative L. In general, the PNV of alternatives and benchmarks vary with the amount of timber harvest in the 1st decade. The amount of timber harvest in the 1st decade ranges from 146.0 MMCF/year in Alternative K to 34.2 MMCF/year in Alternative L. The 1st decade harvest results from the objectives of the alternative which effect 1) the amount of land that would be suitable for timber production, 2) the objective of the timber program (whether to maximize PNV or to maximize the amount of volume available for harvest), and 3) the timber harvest flow objectives. Alternatives with less timber harvest would be less expensive to implement primarily because of fewer reforestation and road costs. However, in most alternatives, the expense of having a large timber and road program would be more than offset by additional receipts from timber sales.

Table B-41. Differences in Economic Efficiency Criteria ¹

Alternative/Benchmark, Ranked by Present Net Value ²	Present Net Value ²		Discounted Costs ²		Discounted Benefits ²	
	<i>Total</i>	<i>Change</i>	<i>Total</i>	<i>Change</i>	<i>Total</i>	<i>Change</i>
NC ³	NA		NA		NA	
K	3,503	-319	3,370	-191	6,874	-511
A	3,184	-124	3,179	-383	6,363	-507
J	3,060	-202	2,796	-170	5,856	-8
W(PA)	2,858	-78	2,626	+32	5,848	-411
D	2,780	-1,173	2,658	-1,622	5,437	-2,795
L	1,607		1,036		2,642	
Maximum PNV	3,782	-303	3,365	-230	7,147	-73
Maximum Timber	3,479	-759	3,595	-1,685	7,074	-2,444
Recreation ⁴	2,720	-1,860	1,910	-1,699	4,630	-3,500
Minimum Level ⁴	860		211		1,130	

¹4% discount rate over 150 years.²In 1982 MM\$.³Comparable values are not available for Alternative NC.⁴Shaded rows were not reanalyzed between DEIS and FEIS.

Table B-42. Differences in Economic Efficiency Criteria ¹

Alternative/Benchmark, Ranked by Increasing Discounted Costs ²	Discounted Costs ²		Discounted Benefits²		Present Net Value ²	
	<i>Total</i>	<i>Change</i>	<i>Total</i>	<i>Change</i>	<i>Total</i>	<i>Change</i>
L	1,036		2,642		1,607	
W(PA)	2,626	+1,590	5,848	+3,206	2,858	+1,251
D	2,658	+32	5,437	+411	2,780	-78
J	2,796	+138	5,856	+419	3,060	+2,780
A	3,179	+383	6,363	+507	3,184	+124
K	3,370	+191	6,874	+511	3,503	+319
NC ³	NA		NA		NA	
Minimum Level	211		1,130		860	
Recreation	1,910	+1,699	4,630	+3,500	2,720	+1,860
Maximum PNv	3,365	+1,455	7,147	+5,692	3,782	+1,062
Maximum Timber	3,595	+230	7,074	-73	3,479	-303

¹4% discount rate over 150 years.²In 1982 MM\$.³Comparable values are not available for Alternative NC.⁴Shaded rows were not reanalyzed between DEIS and FEIS.

Discounted Costs and Benefits

Discounted benefits and costs by resource group are displayed in Tables B-43 and B-44. The discounted costs were reviewed and revised between the DEIS and FEIS to reflect current practices and the current accounting system. The costs developed in the DEIS were based on the Management Information Handbook (MIH) coding system. This system has been replaced by the National Activity Structure Handbook (FSH 1309.16). The cost structure was set up to be similar to the codes used by Forest Service managers in developing outyear budgets. The new cost information was incorporated in Alternatives K, A, J, W, D, and L, and the Timber and PNV benchmarks for the FEIS.

Discounted benefits range from \$6.8 billion for Alternative K to \$2.6 billion for Alternative L. Discounted costs range from \$3.4 billion for Alternative K, to \$1.0 billion for Alternative L. The discounted benefits exceed the discounted costs of all resource groups displayed on Tables B-43 and B-44 except for the "Other" category. The "Other" category would have a negative net value because these programs (primarily general administration, facilities, and protection) have few benefits which have been assigned dollar values.

In all alternatives except Alternative L, timber receipts would contribute about 3/4 of the discounted benefits and timber would account for 60% of the discounted costs. Timber receipts would contribute 48% of the discounted benefits in Alternative L and timber would account for 50% of the discounted costs in Alternative L.

For the timber program the discounted benefits would more than compensate for increases in discounted costs among both alternatives and benchmarks. Other programs, such as recreation, involve changes in quality of the recreation experience which are not all captured in dollar values assigned to recreation use. Thus the dollar benefit values for recreation, fish and wildlife do not always compensate for additional costs and the ranking by costs and benefits does not follow the ranking by PNV. Neither benchmarks nor Alternatives J, W, and D would not be in the same location if the ranking were based on discounted costs. Alternative D makes the largest investments in both wildlife habitat improvements and recreation. Between Alternatives W and J, Alternative W makes the largest investment in recreation facilities. Alternative J makes the largest investment in wildlife habitat improvements.

The recreation, wildlife and fish programs would contribute smaller, but significant positive economic value in all alternatives. The costs of the recreation and wilderness management programs would increase with the amount of land managed for undeveloped and Special Interest Areas and investment in recreational facilities. In all alternatives recreational demand above capacity levels is not valued. Benefits for wildlife and fish would vary primarily with the level of elk habitat and riparian protection, respectively. Costs for wildlife and fish vary primarily from investment in habitat improvement.

Benchmarks also follow the same pattern. The maximum Timber Benchmark incurs greater costs than the PNV Benchmark due to practicing the highest intensity of management on all lands to obtain maximum volume. In contrast the maximum PNV Benchmark incurs cost only on those lands which reap the highest net benefit.

The economic benefits and costs discussed here do not include possible future mineral and energy development. These values are highly speculative because of the low potential for significant development on the Forest. The economic consequences of such unlikely developments would probably not vary significantly between alternatives.

Table B-43. Present Net Value, Discounted Benefits, and Discounted Costs By Resource ¹

	ALTERNATIVE, Ranked in Order of Decreasing PNV						
	NC	K	A	J	W	D	L
DISCOUNTED BENEFITS ² (MM\$)							
Present Net Value	N/A	3,503	3184	3,060	2,858	2,780	1,607
Timber	N/A	5,465	5,123	4,520	4,131	4,010	1,281
Recreation	N/A	1,408	1,239	1,335	1,353	1,427	1,361
Wildlife and Fish ³	N/A	NE	NE	NE	NE	NE	NE
Other ⁴	N/A	0.8	0.8	0.8	0.8	0.8	0.8
DISCOUNTED COSTS² (MM\$)							
Timber	N/A	2,323	2,218	1,915	1,785	1,814	513
Facilities ⁵	N/A	403	376	354	328	284	195
Recreation	N/A	145	113	125	140	170	134
Wildlife and Fish	N/A	141	130	103	96	110	78
Other ⁶	N/A	359	342	299	278	280	114

¹ 4% discount rate over 150 years.

² Comparisons of benefits and costs displayed for individual resource outputs indicate general relationships between alternatives, but they may be misleading because many outputs of multiple use management have common costs of production that cannot be attributed to individual resources.

³ Fish and wildlife related programs were not individually computed for the FEIS, but have been included with recreation.

⁴ Receipts from mineral leases, special uses, recreation user fees, grazing, land uses, and power.

⁵ Primarily road construction, reconstruction, and maintenance related to timber management.

⁶ Costs are for all other programs not elsewhere classified.

ESTIMATING EFFECTS

Table B-44. Present Net Value, Discounted Benefits, and Discounted Costs By Resource ¹

BENCHMARK, Ranked in Order of Decreasing PNV					
	Current Direction (No Action)	PNV	Timber	Recreation²	Minimum Level²
DISCOUNTED BENEFITS ³ (MM\$)					
Present Net Value	3,184	3,782	3,479	2,720	860
Timber	5,123	5,738	5,665	2,850	0
Recreation	1,234	1,403	1,403	1,310	831
Wildlife and Fish ⁴	N/A	N/A	N/A	N/A	N/A
Other ⁵	0.8	0.8	0.8	0.0	0.0
DISCOUNTED COSTS ³ (MM\$)					
Timber	2,218	2,320	2,378	1,364	2
Roads	NE ⁶	NE ⁶	NE ⁶	139	20
Facilities ⁷	376	403	403	NE ⁶	NE ⁶
Recreation	113	143	146	175	30
Wildlife and Fish	130	139	143	8	3
Other ⁸	718	2,678	2,823	221	215

¹ 4% discount rate over 150 years.

² Shaded columns were not reanalyzed between DEIS and FEIS.

³ Comparisons of benefits and costs displayed for individual resource outputs indicate general relationships between alternatives, but they may be misleading because many outputs of multiple use management have common costs of production that cannot be attributed to individual resources.

⁴ Fish and wildlife related programs were not individually computed for the FEIS.

⁵ Receipts from mineral leases, special uses, recreation user fees, grazing, land uses, and power.

⁶ These values were not individually computed

⁷ Primarily road construction, reconstruction, and maintenance related to timber management.

⁸ Costs are for all other programs not elsewhere classified.

Trade-Offs Among Alternatives

This section summarizes the relationships among economic values and the responses of the alternatives to selected issues. The purpose is to highlight major economic and noneconomic trade-offs that can be quantified by using indicators of responsiveness to issues as a means of comparing alternatives. A complete understanding of the differences among alternatives requires reading Chapter II, IV, and Appendix B. The issues are discussed in detail in Chapter I and Appendix A.

To provide a partial framework for assessing trade-offs, the long-term resource demands of the nation, region, and local communities are briefly summarized. Selected economic values and quantified indicators of responsiveness to issues are then tabulated. Finally, differences and similarities among individual alternatives are summarized in terms of major trade-offs among competing objectives or responses to issues.

National, Regional, and Local Overview

The 1984 supplement to the Resources Planning Act (RPA) Assessment estimates that total national demands will rise for all goods and services produced by the National Forests. At the same time, there will be a continuing strong desire to protect and enhance the quality of the environment.

The Regional Guide for the Pacific Northwest Region estimates that demands for all outputs of the National Forests will also rise in Oregon and Washington. Recreation use is expected to increase as the population increases and its characteristics change, with the bulk of recreation use coming from residents of the region. Demand for Wilderness recreation is expected to exceed the available supply within the Region's Wilderness Preservation System.

A survey of recreation associated with fishing, hunting, and wildlife (USDI 1988) indicates that more than three of every four Americans pursue some type of fish or wildlife activity. Demand for hunting and sport fishing is expected to increase by one-third between 1985 and 2000. Nonconsumptive uses of wildlife and fish are also expected to increase.

The National Forests of the Pacific Northwest are the National Forest System's primary timber producer, with almost one-half of the current National Forest harvest coming from this region. The quantity of timber demanded regionally in 2000 is expected to be about 1% greater than the 1976 demand level. The stumpage price of timber, however, is expected to rise substantially.

The local situation is generally similar to that of the Region. Many of the Wilderness and non-Wilderness areas providing primitive and semiprimitive recreation opportunities are currently being used at levels which exceed their capacity to provide high quality experiences. The demand for this type of recreation on the Forest is expected to increase over the next 10 to 50 years.

Demand for timber from the Forest is also projected to increase over the next 10 to 15 years due to anticipated reductions in supply from private and other public lands in the central and southern Willamette Valley together with a strong market for wood products and fiber.

Growth in the recreation and tourism sectors of local and regional economies will add to the economic base, while the timber industry will remain a significant component of the area economy. These trends are discussed more thoroughly in the social and economic environment and timber sections of Chapter III of the FEIS.

Economic Values and Response to Major Issues, Concerns, and Opportunities

Alternatives are developed to provide different responses to public issues identified on the Forest. This section summarizes the quantifiable differences among alternatives in terms of economic criteria and responses to major issues. These issues are discussed in detail in Chapter I. A complete discussion of these indicators and their relationship to the major issues can be found in Appendix A, *Issues, Concerns, and Opportunities Identification Process*.

The response of the alternatives to the ICOs or group of ICOs is summarized in Table B-45. The items on the table are key indicators of the degree of response to the 12 major ICOs (additional indicators are given in Chapter I). The first 7 indicators resulted from an in-depth analysis of the public responses received in early 1981 and continued to be of highest concern during the comment period on the DEIS. The "other" indicators were selected because they reflect quantifiable social and economic effects of both local and national concern.

The issues and associated indicators of responsiveness include:

- **Dispersed Recreation**

- Land allocated to semiprimitive nonmotorized uses.
 - Land allocated to semiprimitive motorized uses.
 - Land allocated to Special Interest Areas.
 - Trail construction in the 1st decade.

- **Old-Growth**

- Amount of old-growth/mature timber retained at the end of the 1st decade.

- **Roadless Lands**

- Acres of roadless areas left undeveloped.

- **Scenic Quality**

- Land allocated to a retention Visual Quality Objective.
 - Land allocated to a partial retention Visual Quality Objective.
 - Land allocated to a modification Visual Quality Objective.

- **Timber Supply**

- Allowable sale quantity in the 1st decade.
 - Long-term sustained yield.

- **Water**

- Forest area with a "High" Risk watershed risk rating.
 - Forest area with a "Moderate" Risk watershed risk rating.
 - Forest area with a "Low" Risk watershed risk rating.
 - Erosion in the 1st decade (debris slides).

- Wildlife, Fish, and Plant Habitat

Land managed as spotted owl habitat areas.

Elk population in the 1st decade.

Deer population in the 1st decade.

Other indicators of both local and national concern include those which reflect the social and economic effects of alternatives. The quantifiable indicators of these concerns include:

- Present net value over 15 decades.
- Change in jobs in the 1st decade.
- Change in income in the 1st decade.
- Change in payments to counties in the 1st decade.
- Average annual net cash flow in the 1st decade.

Table B-45 displays the data for each indicator for all the alternatives.

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Table B-45. Tradeoffs of Economic Benefits and Indicators of Response to Issues

Issues	Max PNV Bench -mark	Units	NC	K	A	J	W	D	L
Economics									
PNV	3.8	\$MMM	NA*	3.5	3.2	3.1	2.9	2.8	1.6
Cash Flows 1st decade	85.5	\$MM/Yr	NA	66	62	54	52	42	6
5th decade	82.0	\$MM/Yr	NA	88	79	86	72	52	6
Noncash Benefits 1st Decade	40.2	\$MM/Yr	39	40	41	41	40	38	41
5th decade	71.2	\$MM/Yr	NA	71	53	60	62	74	63
Payments to Counties	36.6	\$MM/Yr	39	32	30	27	25	23	8
Changes in Income ¹	80.5	MM/Yr	156	74	53	14	-6	-15	-173
Changes in Jobs ¹	2665 ²	Number	5653	2945	2218	900	204	-167	-5499
Timber									
ASQ ⁷	660	MMBF	810	650	608	530	491	476	150
ASQ ⁷	113	MMCF	146	117	110	95	87	86	27
Long-Term Sustained Yield	123	MMCF	146	120	114	108	95	94	34
Recreation									
Special Interest Areas	NE ²	M Acres ⁴	1.1	2.8	1.1	22.6	31.1	15.2	3.4
Trail Construction ⁷	NE ²	Miles	0	0	0	4.0	6.0	6.8	4.0
Semiprimitive Nonmotorized		M Acres ⁴	75.3	14.4	72.2	89.5	85.8	176.5	102.0
Semiprimitive Motorized		M Acres ⁴	23.9	48.3	23.4	31.3	36.0	38.2	66.3
Water									
Low Watershed Risk ⁶	NE ²	% Area	NA	41	47	65	100	78	100
Moderate Watershed Risk ⁶	NE ²	% Area	NA	27	25	17	0	10	0
High Watershed Risk ⁶	NE ²	% Area	NA	29	28	18	0	12	0
Erosion (Debris Slides) ⁷	NE ²	M C.Yds	NA	85.6	80.3	67.0	28.5	33.4	23.9
Wildlife									
Spotted Owl Habitat	59	# Areas ⁴	0	59	59	59	59	102	184
Elk Population	NE ²	M Elk ⁶	NA*	3.7	4.2	4.5	4.8	5.6	5.6
Deer Population	NE ²	M Deer ⁶	NA*	17.8	19.5	23.1	24.9	28.4	26.6
Scenic Quality									
Retention		M Acres ⁴	88.6	72.0	77.9	90.5	118.8	142.1	265.1
Partial Retention		M Acres ⁴	114.3	147.5	150.1	177.7	171.7	246.7	286.3
Modification		M Acres ⁴	4.5	123.6	4.5	206.2	143.0	108.4	4.5
Old Growth									
Acres Remaining After 10 Years	520.7	M Acres	494.0	522.4	528.4	534.9	533.4	537.2	578.3
Roadless									
Area Allocated to Roadless	0	M Acres ⁴	45.4	25.3	59.8	79.7	92.1	136.9	145.9

¹Changes represent the total potential change in the 1st decade as compared to the historical average (1980-1989)

²NE = Not estimated, benchmarks were not analyzed as fully developed implementable alternatives.

³NA = Data Not Available; could not be reasonably estimated, or compared to other alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other Alternatives, and could not be modeled with the current Forest FORPLAN model. See alternative Considered in Detail, Chapter II for additional information.

⁴Represents lands allocated to meet this objective.

⁵Percent of total Forest area at the end of the 1st decade in this watershed risk category. See Chapter IV, Water for further explanation.

⁶Represents end of 1st decade conditions.

⁷Units are average annual for 1st decade.

Differences and Similarities Among Alternative

This section describes the major differences and similarities among alternatives in terms of the indicators of responsiveness listed in the previous section. The major factors influencing the economic indicators are described in *Response to Issues and Concerns*, Chapter II. More details on the outputs and effects of the alternatives can be found in the individual resource sections in Chapter IV. Table B-45 contains data used for these discussions; Tables II-24 through II-26 in Chapter II may also provide some supplemental information. The alternatives are described in order of decreasing present net value (PNV). The indicators for each issue are discussed sequentially for each alternative. Information for the maximum PNV benchmark is provided only as a reference point. Qualifiers such as low or high used in these discussions are relative to the upper and lower level of each output shown in Table B-45.

While each alternative would meet MRs, multiple use requirements, and sustained yield requirement, the goal of each alternative is to benefit one or more resources outputs. To achieve this, other resource outputs must be reduced or "traded off". Those tradeoffs are discussed here by focusing on the incremental differences between the alternatives, starting with the alternative which has the highest PNV. The focus of the discussion is on 1) reasons for differences in economic values and 2) differences which are not fully reflected in the PNV. Alternatives are compared with the other alternatives and with the PNV benchmark. The accompanying table uses summarizes the tradeoffs associated with achieving a higher PNV. For a detailed discussion the Roadless, Water and Vegetation sections of Chapter IV describe the relationship of these effects in more detail.

The indicators that could be estimated for the No Change Alternative are displayed in Table B-45 and are described in this section. Many indicators could not be reasonably estimated because Alternative NC (No Change) is based on a set of assumptions different than were the other alternatives and could not be modeled with the current Forest FORPLAN model. *Alternatives Considered In Detail*, Chapter II describes these differences.

Most of the variation in economic response factors described in *Response to Issues and Concerns*, Chapter II, can be directly related to the amount of timber harvest in an alternative. This pattern does vary somewhat as a result of the level of recreation oriented benefits provided by an alternative. Alternatives with greater emphasis on recreation have higher levels of recreation benefits. Jobs and personal income variations among alternatives follow the same kinds of patterns as the other economic indicators.

Maximum PNV Benchmark - PNV: \$3.8 Billion - Opportunity Cost: None (Baseline for Comparison)

The Maximum PNV Benchmark identifies the mix of goods and services with market and assigned values that result in the largest excess of discounted benefits over discounted costs. It meets MRs for resource protection and produces a high level of timber harvest on a nondeclining yield schedule. It is summarized in Table B-45 for comparison purposes.

Alternative NC (No Change) - PNV: NOT AVAILABLE - Opportunity Cost: NOT AVAILABLE

Alternative NC would produce the highest level of timber of any alternative (allowable sale quantity of 146 million cubic feet annually). This figure represents the potential yield from the current Forest Land and Timber Management Plan (1977). Although many indicators were not estimated for this alternative, present net value, net cash flows, payments to counties, income, and jobs would all likely be at their highest level with this alternative due to the high level of timber harvest. Conversely, the amount of old growth remaining at the end of the 1st decade would be at the lowest level of any alternative.

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Forest land allocations for dispersed recreation, roadless areas, and scenic management areas are those in the current Forest Plan (1977) and are intermediate within the range of alternatives. Since MRs are not a part of this alternative, spotted owl habitat areas would be located only where some other allocation prohibited timber harvesting. Consequently, they are at their lowest level with this alternative. Deer and elk populations were not estimated for this alternative. Although quantitative estimates of watershed impact ratings and erosion were not made for this alternative, the amount of land in the "high" watershed risk category, and the amount of erosion would likely be at their highest level due to the high timber harvest level.

Table B-46 summarizes the tradeoffs of Alternative NC with the PNV Benchmark.

Table B-46. Comparison of Alternative NC with PNV Benchmark

Selected Issues	Units	Alt NC	Change From PNV Benchmark
PNV	\$MMM	NA ³	NA ³
Non-cash Benefit	\$MM/Yr	39	0
ASQ ¹	MMBF	810	+ 150
ASQ ¹	MMCF	146	+ 33
LTSY	MMCF	146	+ 23
Changes in Jobs ²	Number	5653	+2988
Old Growth Remaining After 10 Years	M Acres	494	- 27

¹ Units are average annual for 1st decade

² Changes represent total potential change in the first decade as compared to the historical average (1980-1989)

³ Data not available

Alternative K (Willamette Forestry Council) - PNV: \$3.5 Billion - Opportunity Cost: \$297 Million as compared to Maximum PNV

With the exception of Alternative NC, Alternative K would produce the highest level of timber of any alternative on a nondeclining yield schedule (117 million cubic feet annually in the 1st decade). This is 29 million cubic feet or 20% less than the harvest level under Alternative NC because of land allocations and application of management prescriptions to meet MRs for water, soil, and wildlife resources. The areas available for spotted owl habitat would increase by 14 for a total of 59 areas in Alternative K. As a result of the lower timber harvest levels, all of the economic indicators are correspondingly lower also. The acres of old growth left at the end of the 1st decade would be 522.4 M acres or 28.4 M acres more than Alternative NC.

The number of Forest acres allocated to dispersed recreation and roadless area retention are similar to Alternative NC, overall. There is, however, an increase in Alternative K of acres managed to meet a modification visual objective. Although watershed risk was not estimated for Alternative NC, based on the rate of harvest it is likely the effects would be similar to Alternative K; 29% of the Forest in the high risk category and 27% of the area at moderate risk of adverse watershed impacts.

Table B-47 summarizes the tradeoffs associated with Alternative K with respect to the PNV Benchmark and Alternative NC.

Table B-47. Comparison of Alternative K with PNV Benchmark and Alternative NC

Selected Issues	Units	Alt K	Change From PNV Bench-mark	Change From Alt NC
PNV	\$MMM	3.5	- 0.3	NA ³
Non-cash Benefit	\$MM/Yr	40	+ 1	+ 1
ASQ ¹	MMBF	650	- 10	- 160
ASQ ¹	MMCF	117	+ 4	- 29
LTSY	MMCF	120	- 3	- 26
Changes in Jobs ²	Number	2945	+280	-2708
Old Growth Remaining 1st Decade	M Acres	522.4	+ 1.7	+ 28.0

¹ Units are average annual for 1st decade

² Changes represent total potential change in the first decade as compared to the historical average (1980-1989)

³ Data not available

Alternative A (No Action) - PNV: \$3.2 Billion - Opportunity Cost: \$319 Million as compared to Alternative K.

Alternative A would continue management of the Forest under the existing Forest Land and Timber Management Plan (1977); however, Forest direction is modified in this Alternative to meet MRs. The timber harvest under Alternative A, 110 million cubic feet, is a decrease of 7 million cubic feet per year from the harvest level under Alternative K. Present net value, payments to counties, and net cash flow drop slightly from the Alternative K level. Income and the number of jobs decrease proportionally with the timber harvest levels. Alternative A would retain 528.4 M acres of old growth at the end of the first decade or 6 M acres more than in Alternative K.

Forest land allocations for dispersed recreation, roadless areas, and scenic management areas (with the exception of Modification in K) are higher in Alternative A as compared to Alternatives K and NC. Spotted owl habitat areas would be protected at the MR level or the same level as Alternative K. Deer and elk populations in Alternative A would show a slight increase over Alternative K. Elk populations increase in Alternative A as compared to Alternative K due to a better balance of cover and forage habitat components and overall habitat quality. The watershed risk levels are similar between Alternatives K and A with over 50% of the Forest at high to moderate risk of adverse watershed effects.

Table B-48 summarizes the tradeoffs associated with the Alternative A with respect to the PNV Benchmark and Alternative K.

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Table B-48. Comparison of Alternative A with PNV Benchmark and Alternative K

Selected Issues	Units	Alt A	Change From PNV Bench-mark	Change From Alt K
PNV	\$MMM	3.2	- 0.6	- 0.3
Non-cash Benefit	\$MM/Yr	41	+ 2	+ 1
ASQ ¹	MMBF	608	- 52	- 202
ASQ ¹	MMCF	110	- 3	- 7
LTSY	MMCF	114	- 9	- 32
Changes in Jobs ²	Number	2218	-447	-3435
Old Growth Remaining 1st Decade	M Acres	528.4	+ 7.7	+ 6.0

¹ Units are average annual for 1st decade

² Changes represent total potential change in the first decade as compared to the historical average (1980-1989)

Alternative J (DEIS Preferred) - PNV: \$3.1 Billion - Opportunity Cost: \$124 Million as compared to Alternative A.

Alternative J was formulated to provide relatively high levels of timber on a nondeclining yield basis in combination with production of amenity resources at intermediate levels. Timber harvest would be 95 million cubic feet annually. This level is 15 million cubic feet or 14% less than the first decade annual harvest in Alternative A. The difference in timber harvest between these two alternatives is due to more acres that would be managed for nontimber uses such as dispersed recreation and additional acres of reduced yields such as Retention and Partial Retention scenic objectives. Present net value, net cash flows, payments to counties, personal income, and the number of jobs are less in the first period as compared to Alternative A reflecting the increased emphasis on amenity resources. In Alternative J, 534.9 M acres of old growth or 6.5 M additional acres would remain under Alternative J after 10 years as compared to Alternative A. The amount of existing roadless area allocated to roadless prescriptions is 20 M acres greater in Alternative J than in A. The amount of new trails that would be built in Alternative J is 40 miles over the decade, as compared to no new trail construction in Alternative A.

Deer and elk populations increase slightly in Alternative J reflecting the increased amounts of optimum cover and other habitat enhancements. Spotted owl habitat would be provided at the MR level of 59 areas, unchanged from Alternative A. The lower first decade harvest level in Alternative J results in a 35% of the Forest area in a high or moderate risk category for adverse watershed effects as compared to 55% in the same categories in Alternative A.

Table B-49 summarizes the tradeoffs associated with Alternative J with respect to the PNV Benchmark and Alternative A.

Table B-49. Comparison of Alternative J with PNV Benchmark and Alternative A

Selected Issues	Units	Alt J	Change From PNV Bench-mark	Change From Alt A
PNV	\$MMM	3.1	- 0.7	- 0.1
Non-cash Benefit	\$MM/Yr	41	+ 2	0.0
ASQ ¹	MMBF	530	- 130	- 78
ASQ ¹	MMCF	95	- 18	- 15
LTSY	MMCF	108	- 15	- 6
Changes in Jobs ²	Number	900	-1765	-1318
Old Growth Remaining 1st Decade	M Acres	534.9	+ 14.2	+ 6.5

¹ Units are average annual for 1st decade

² Changes represent total potential change in the first decade as compared to the historical average (1980-1989)

Alternative W (FEIS Preferred) - PNV: \$2.9 Billion - Opportunity Cost: \$202 Million as compared to Alternative J.

Alternative W emphasizes the management of both commodity and noncommodity resources on the Forest at levels that would recognize the importance of maintaining intact, functional ecosystems and long term productivity. The timber harvest level in Alternative W would be 87 million cubic feet or 8% less than in Alternative J. Cash flows and payments to counties are only slightly less than in Alternative J, but other economic indicators show significant reductions. Spotted owls would be managed at the MR level of 59 areas, the same as Alternative J.

The amount of the Forest at high to moderate risk of adverse watershed effects decreases to 0%, a significant change from Alternative J. In addition, 12.4 M additional acres would be managed in a roadless condition. The amount of trails to be constructed in the first decade increases by 20 miles over the amount proposed in Alternative J to a total of 60 miles in Alternative W. Overall, the dispersed recreation opportunities in Alternatives J and W are similar. The acres of old growth remaining after 10 years shows a slight reduction (1,500 acres) from Alternative J. Elk and deer populations would increase slightly from Alternative J as a result of increased acres of optimal cover and additional emphasis on habitat management.

Table B-50 summarizes the tradeoffs associated with Alternative W with respect to the PNV Benchmark and Alternative J.

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Table B-50. Comparison of Alternative W with PNV Benchmark and Alternative J

Selected Issues	Units	Alt W	Change From PNV Bench- mark	Change From Alt J
PNV	\$MMM	2.9	- 0.9	- 0.2
Non-cash Benefit	\$MM/Yr	40	+ 1	1
ASQ ¹	MMBF	491	- 169	- 39
ASQ ¹	MMCF	87	- 26	- 8
LTSY	MMCF	95	- 28	- 13
Changes in Jobs ²	Number	204	- 2461	- 696
Old Growth Remaining 1st Decade	M Acres	533.4	+ 12.7	- 1.5

¹ Units are average annual for 1st decade

² Changes represent total potential change in the first decade as compared to the historical average (1980-1989)

Alternative D (Wildlife) - PNV: \$2.8 Billion - Opportunity Cost: \$78 Million as compared to Alternative W.

Alternative D places a high emphasis on the management of wildlife and other amenity resources. This level of management would require reductions in the acres where timber is the primary production goal. The timber sale level under Alternative D is 86 million cubic feet which is similar to Alternative W. First period jobs, personal income, payments to counties, net cash flow, and present net value are also reduced slightly compared to Alternative W. The old growth remaining at the end of the first decade would be 537.2 M acres or less than a 1% increase over Alternative W.

The increased emphasis on amenity resources would result in more acres allocated for semiprimitive nonmotorized dispersed recreation, scenic zones, roadless areas, and spotted owl habitat areas, as compared to Alternative W. The significant changes between Alternative W and Alternative D are in wildlife and watershed outputs and effects. In Alternative D, the number of designated spotted owl habitat areas is 102 compared to the MR level of 59 in Alternative W. Elk and deer populations would increase by 15 to 20% over Alternative W due to an emphasis on high quality habitat conditions and enhancement projects.

The amount of the Forest in the high to moderate risk category for adverse watershed effects increases from 0% in Alternative W to 22% in Alternative D. This increase is due largely to a harvest level similar to Alternative W on a smaller suitable land base and the decreased emphasis in Alternative D to maintain favorable watershed conditions at the subdrainage level.

Table B-51 summarizes the tradeoffs associated with Alternative D with respect to the PNV Benchmark and Alternative W.

Table B-51. Comparison of Alternative D with PNV Benchmark and Alternative W

Selected Issues	Units	Alt D	Change From PNV Bench-mark	Change From Alt W
PNV	\$MMM	2.8	- 1.0	- 0.1
Non-cash Benefit	\$MM/Yr	38	- 1	- 2
ASQ ¹	MMBF	476	- 184	- 15
ASQ ¹	MMCF	86	- 27	- 1
LTSY	MMCF	94	- 29	- 1
Changes in Jobs ²	Number	- 167	- 2832	- 371
Old Growth Remaining 1st Decade	M Acres	537.2	+ 16.5	+ 3.8

¹ Units are average annual for 1st decade

² Changes represent total potential change in the first decade as compared to the historical average (1980-1989)

Alternative L (Oregon Natural Resources Council) - PNV: \$1.6 Billion - Opportunity Cost: \$1,173 Million as compared to Alternative D.

Alternative L emphasizes the protection of remaining old growth and maintenance of the natural attributes of the Forest. Achievement of these goals would require further reductions in the acres where the primary goal is timber production. The timber harvest level is 27 million cubic feet or 59 million cubic feet less than Alternative D, and is the lowest of all alternatives. All the economic indicators are at their lowest level, reflecting the low timber harvest level. Conversely, Alternative L would retain the greatest amount of old growth at the end of the first decade of all the alternatives with 578.3 M acres or 41.1 M acres more than Alternative D.

Alternative L would maintain all of the current inventory of roadless area in a roadless condition. Approximately 145.9 M acres are allocated to roadless management prescriptions and an additional 169.4 M acres would be recommended for Wilderness designation. The acres that would be maintained in roadless allocations in Alternative L are the most of any alternative. In addition, 184 spotted owl habitat areas, enough to protect the known owl population outside of Wilderness, would be preserved. Deer populations would decrease due to the decrease in forage as a result of lower timber harvest levels. Due to the low level of timber harvest and large amount of land maintained in a natural condition, 0% of the Forest would be in the high or moderate risk category for adverse watershed effects. This is 22% less than the acres similarly rated under Alternative D.

Table B-52 summarizes the tradeoffs associated with Alternative L with respect to the PNV Benchmark and Alternative D.

Table B-52. Comparison of Alternative L with PNV Benchmark and Alternative D

Selected Issues	Units	Alt L	Change From PNV Bench- mark	Change From Alt D
PNV	\$MMM	1.6	- 2.2	- 1.2
Non-cash Benefit	\$MM/Yr	41	+ 2	+ 3
ASQ ¹	MMBF	150	- 510	- 326
ASQ ¹	MMCF	27	- 86	- 59
LTSY	MMCF	34	- 89	- 60
Changes in Jobs ²	Number	-5499	-8164	-5332
Old Growth Remaining 1st Decade	M Acres	578.3	+ 57.6	+ 41.1

¹ Units are average annual for 1st decade

² Changes represent total potential change in the first decade as compared to the historical average (1980-1989)